

Kennedy NASA Procedural Requirements

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Responsible Office: Safety and Mission Assurance

KSC Safety Procedural Requirements

Volume 1, Safety Procedural Requirements for Civil Servants/NASA Contractors

National Aeronautics and
Space Administration

John F. Kennedy Space Center

KDP-KSC-T-2120 Rev. Basic

**KNPR 8715.3-1, KSC Safety Procedural Requirements
Volume 1, Safety Procedural Requirements for Civil Servants/NASA Contractors
Rev. C**

Change Log

Date	Revision	Description
6/28/2012	Basic	Kennedy NASA Procedural Requirements (KNPR) 8715.3 went through a major reorganization. KNPR 8715.3 has been divided into three volumes and a user's guide (KSC-UG-8715.3, KSC Safety User's Guide) in accordance with applicability: Volume 1, Safety Procedural Requirements for Civil Servants/NASA Contractors (KNPR 8715.3-1); Volume 2, Safety Procedural Requirements for Partner Organizations Operating in Joint-Use Facilities (KNPR 8715.3-2, to be completed at a later date); and Volume 3, Safety Procedural Requirements for Tenant Organizations Operating in Exclusive-Use Facilities (KNPR 8715.3-3, to be completed at a later date). KSC-UG-8715.3, KSC Safety User's Guide, contains best practices, guidance, and helpful information and mirrors the numbering of the volumes to aid in cross-referencing.
4/29/2013	Basic-1	Administratively changed to: 1. Update references to KSC-US-8715.3 in Sections 4.2.1, 4.2.2 and 10.1.2 and in Appendix D. 2. Update Section 5.2.5.1 to clarify the Lockout/Tagout retraining requirements by referencing the Federal requirements documented in NFPA 70E.
7/3/2013	Basic-2	Administratively changed 5.3 e. to update the tag reference for use on Emergency Eyewash & Shower Equipment that are nonoperational, noncompliant with ANSI, or in unoccupied facilities.
7/17/2013	Basic-2_Interim	An Interim Change Letter was signed by the Safety and Mission Assurance Director on July 17, 2013. This interim change is to update two requirements (Maximum Work Time and Electrical Appliances in Cubicles).
6/25/2014	Basic-2_Interim-2	An Interim Change Letter was signed by the Safety and Mission Assurance Acting Director on June 25, 2014. This interim change is to requirements for Composite Overwrapped Pressure Vessels.
6/14/2017	Basic-3	Administratively changed to extend expiration date from June 28, 2017 to October 27, 2017. Document revisions are in S&MA internal review prior to Center wide review.
10/25/2017	A	This revision contains updates to both the content and the structure/organization of the document. The changes have been based on document change requests from the community, lessons learned through the implementation of the requirements, and an independent assessment performed on the document. Significant updates include (not all inclusive): 1. Moving the Fall Protection requirements into KSC-STD-S-0033 and requiring the use of the standard in this document. 2. Updating the lightning requirements.

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		<ul style="list-style-type: none"> 3. Incorporating interim changes on composite overwrapped pressure vessels requirements, maximum work time requirements, and electrical appliances in cubicles requirements. 4. Updating the process for recommending changes to the document. 5. Adding the CSO as a concurrence on requests for relief. 6. Removing section 8.1 on flight COPVs
11/8/2017	A-1	Administratively changed to update link to KSC-STD-S-0033 on pages 10 and 35 from KEDS/TDOPS links to TDCOMM links.
6/4/2018	A-1 Interim	This interim change depicts modifications to three existing requirements and the addition of three new requirements as outlined in the memo from the Director, Safety and Mission Assurance, dated May 14, 2018.
1/6/2020	B	Updates have been made to incorporate interim changes and modify requirements regarding Lightning, Maximum Work Time, Cryogenics, PVS, Explosives, and Lifting in Chapters 3, 4, 6, 7, 9, 10 and Appendix A. Wind requirements, Section 6.2.12, was also added in this revision.
8/17/2022	C	Updates and review were only completed for Chapter 2, Requests for Relief from Safety and Mission Assurance Technical Authority Requirements. Updates made to Chapter 2 to allow for revisions to Requests for Relief and to align with the updates made to NPR 8715.1. Added a definition for Request for Relief Coordinator to Appendix A.

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PREFACE

P.1 PURPOSE

This document establishes Kennedy Space Center (KSC)-specific safety requirements for design, operations, and maintenance activities. The requirements herein and higher-level National Aeronautics and Space Administration (NASA) Agency requirements [e.g., NASA Procedural Requirements (NPR)] and Federal requirements [e.g., the Occupational Safety and Health Administration (OSHA) requirements in [Title 29 of the Code of Federal Regulations \(29 CFR\)](#)] are applicable at KSC and other areas where KSC has jurisdiction. These requirements represent combined efforts to identify and mitigate the unique hazards associated with daily institutional operations and ground processing operations at KSC. Furthermore, each employee has a responsibility for safety, both his/her own and that of others who may be impacted by the employee's actions.

P.2 APPLICABILITY

- a. This Kennedy NASA Procedural Requirements (KNPR) document is applicable to NASA KSC Civil Servants and to NASA KSC contractors (including subcontractors, service providers, and construction contractors) as specified in their contracts. These provisions are also applicable at offsite facility areas where KSC has operational responsibility.
- b. This KNPR is only applicable to other organizations (e.g., commercial partners, other Federal agencies, international parties, and tenants) as specified and described in written agreements.
- c. Compliance with applicable higher-level requirements (e.g., 29 CFR OSHA and Agency directives) is mandatory even though the requirements are not called out specifically in this KNPR. The KNPR requirements may be more stringent and are applicable in addition to the higher-level requirements but do not supersede the higher-level requirements.
- d. In the event of a conflict between the requirements set forth in this document and:
 - (1) Program or Agency requirements, the more stringent requirements take precedence.
 - (2) Existing contract provisions, the contract provisions take precedence.
 - (3) Sub-tier documents, the provisions of this document take precedence.
 - (4) Other documents at an equivalent level (e.g., other KNPR documents), the respective document offices of primary responsibility will resolve the conflict on a case-by-case basis and provide appropriate guidance.
- e. If disagreement exists over which of the aforementioned documents takes precedence, the NASA KSC Director, Safety and Mission Assurance (SMA) will make the final determination.
- f. In this KNPR, all mandatory actions (i.e., requirements) are denoted by statements containing the term "shall." The terms "may" or "can" denote discretionary privilege or permission, "should" denotes a good practice and is recommended, but not required, "will" denotes an expected outcome, and "are/is" denotes descriptive material.

g. In this KNPR, all document citations are assumed to be the latest version unless otherwise noted.

P.3 AUTHORITY

- a. [Title 29 Code of Federal Regulations \(CFR\), Part 1960, Basic Program Elements for Federal Employees Occupational Safety and Health Program](#)
- b. [Title 29 CFR, Parts 1910 to 1990, Occupational Safety and Health Administration](#)
- c. [Executive Order 12196, Occupational Safety and Health Program for Federal Employees](#)
- d. [NASA Policy Directive \(NPD\) 8700.1, NASA Policy for Safety and Mission Success](#)
- e. [NPR 8715.3, NASA General Safety Program Requirements](#)
- f. [NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping](#)
- g. [KNPD 8700.1, Safety and Mission Assurance Policy Directive](#)

P.4 APPLICABLE DOCUMENTS

- a. [NPD 8710.5, Policy for Pressure Vessels and Pressurized Systems](#)
- b. [NPR 1441.1, NASA Records Retention Schedule](#)
- c. [NPR 1800.1, NASA Occupational Health Program Procedures](#)
- d. [NPR 8705.2, Human-Rating Requirements for Space Systems](#)
- e. [NPR 8715.5, Range Flight Safety Program](#)
- f. [NPR 8715.6, NASA Procedural Requirements for Limiting Orbital Debris](#)
- g. [NPR 8715.7, Expendable Launch Vehicle Payload Safety Program](#)
- h. [NASA-STD-5005, Standard for the Design and Fabrication of Ground Support Equipment](#)
- i. [NASA-STD-6001, Flammability, Offgassing, and Compatibility Requirements and Test Procedures](#)
- j. [NASA-STD-8709.20, Management of Safety and Mission Assurance Technical Authority \(SMA TA\) Requirements](#)
- k. [NASA-STD-8719.9, Lifting Standard](#)
- l. [NASA-STD-8719.11, Safety Standard for Fire Protection](#)
- m. [NASA-STD-8719.12, Safety Standard for Explosives, Propellants, and Pyrotechnics](#)

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- n. [NASA-STD-8719.14, Process for Limiting Orbital Debris](#)
- o. [NASA-STD-8719.17, NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems \(PVS\)](#)
- p. [KNPR 1820.3, KSC Hearing Loss Prevention Program](#)
- q. [KNPR 1820.4, KSC Respiratory Protection Program](#)
- r. [KNPR 1840.1, KSC Hazard Communication Program](#)
- s. [KNPR 1840.19, KSC Industrial Hygiene Program](#)
- t. [KNPR 1860.1, KSC Ionizing Radiation Protection Program](#)
- u. [KNPR 1860.2, KSC Nonionizing Radiation Protection Program](#)
- v. [KNPR 4000.1, Supply and Equipment System Manual](#)
- w. [KNPR 8700.2, KSC Systems Safety and Reliability Analyses Methodology Procedural Requirements](#)
- x. [KNPR 8715.2, Comprehensive Emergency Management Plan \(CEMP\)](#)
- y. [KSC-STD-S-0033, KSC Fall Protection Standard](#)
- z. [KDP-KSC-F-3614, KSC SMA Request for Relief Form](#)
- aa. [KTI-5212, Material Selection List for Plastic Films, Foams, and Adhesive Tapes](#)
- bb. [KSC-MMA-1985-79, Standard Test Method for Evaluating Triboelectric Charge and Decay](#)
- cc. [KSC-UG-8715.3, KSC Safety User's Guide](#)
- dd. [KSC-PLN-2807, Mishap Preparedness and Contingency Plan](#)
- ee. [KSC-PLN-5000 SIMS Spaceport Integrated Master Schedule](#)
- ff. [KSC-PLN-8719 PVS, Kennedy Space Center Pressure Systems Management Plan](#)
- gg. [KSC Form 2-271, Hot Work, New Construction, Demolition Permit](#)
- hh. [KSC Form 4-30A, Deviation](#)
- ii. [KSC Form 6-22, Safety Statistics Record](#)
- jj. [KSC Form 50-260, Notice Temporarily Out of Service Tag](#)
- kk. [KSC Form 20-165, Danger- Do Not Use or Operate](#)
- ll. [KSC Form 20-195, Danger Tag, Lockout/Tagout – 29CFR1910.147](#)

- mm. [KSC Form 20-195a, Label, Danger Lockout/Tagout](#)
- nn. [KSC Form 20-200, Approval Sheet for Suspended Load Operations](#)
- oo. [KSC Form 20-202, KSC Emergency Eyewash/Shower Inspection](#)
- pp. [National Fire Protection Association 780, Standard for the Installation of Lightning Protection Systems](#)
- qq. [KSC Risk Management Scorecard](#)
- rr. [KSC Drawing 81K00643, Specification for Marking of Mobile GSE](#)
- ss. [KSC Drawing 81K04331, Specification for Marking of Propellant Portable Containers](#)
- tt. [45 Space Wing Instruction \(SWI\) 15-101, Weather Support](#)

P.5 MEASUREMENT/VERIFICATION

Compliance with the requirements contained in this KNPR will be verified through normal surveillance, audit, and assessment activities performed by the NASA SMA organization. NASA safety personnel or their designees have the right to enter any NASA KSC-controlled facility to monitor operations in order to accomplish this verification. These safety personnel are subject to safety practices and reasonable security requirements.

P.6 CANCELLATION

This document cancels KNPR 8715.3-1, Revision B, KSC Safety Procedural Requirements, Volume 1, Safety Procedural Requirements for Civil Servants/NASA Contractors.

/original digitally signed by/

P.R. Rodriguez
Director, Safety and Mission Assurance

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CHAPTER 1: GENERAL REQUIREMENTS

1.1 GOAL

The goal of this document is to provide Center safety requirements that ensure activities and operations are performed in a manner that minimizes risk to the public, personnel, hardware, and facilities.

1.2 OBJECTIVE

The objective of this KNPR is to document Center safety requirements, to establish procedural requirements unique to KSC, and to effectively and efficiently convey safety requirements to the Center that protect NASA employees (Civil Servants and Contractor), visitors, the public, NASA hardware, and NASA KSC-controlled facilities.

1.3 RESPONSIBILITY

- a. Final authority and responsibility for implementing the NASA Safety Program at KSC rests with the Center Director. The Center Director has delegated the responsibility for assessing and ensuring compliance with SMA programs at the Center to the NASA KSC Director of SMA. KSC program/project and directorate organizations have responsibilities for implementing the safety program with support from SMA. These responsibilities and those assigned to other Center organizational elements are set forth in detail in [Kennedy NASA Policy Directive \(KNPD\) 8700.1, KSC Safety and Mission Assurance Policy Directive](#).
- b. Ownership of this KNPR resides with SMA Institutional Division. The interpretation of the requirements in this KNPR is the responsibility of the SMA Institutional Division with the appropriate SMA organizations that support the program/project and directorates. The NASA KSC Director of SMA is the final authority for interpretation of these requirements.
- c. When unsafe or unhealthful conditions/acts pose an imminent danger to personnel or property, all employees have the right and obligation to exercise stop work authority or refuse to perform work they feel is unsafe or unhealthful, and collaborate with their management to determine how the activity can be performed in a safe and healthful manner.
- d. Employees have the right and responsibility to notify their supervision of unsafe and unhealthful conditions or acts. Reprisal or disciplinary action against an employee who initiates a safety concern will not be tolerated.

1.4 SAFETY REQUIREMENT VIOLATIONS

- a. Violations of safety requirements by civil service personnel may result in disciplinary actions up to removal from government service.
- b. Violations of safety requirements by contractor employees or visitors could result in being barred from the Center.

1.5 CHANGE RECOMMENDATIONS

- a. SMA change recommendations involving this document shall be submitted to the point-of-contact (POC) identified in TechDoc.
- b. The recommendation should identify the exact language of the proposed change and the rationale for the change.

Note: SMA will ensure proper review and disposition of all change recommendations.

**CHAPTER 2: REQUESTS FOR RELIEF FROM SAFETY AND MISSION ASSURANCE
TECHNICAL AUTHORITY REQUIREMENTS**

a. When Center or higher-level Agency or Federal safety requirement(s) cannot be met, the operating organization (contractor or NASA) shall submit a request for relief using [KDP-KSC-F-3614](#), KSC SMA Request for Relief Form.

Note 1: Relief is requested using [KDP-KSC-P-3614](#) KSC SMA Request for Relief Process.

Note 2: In accordance with [NPR 8715.1](#), NASA Safety and Health Programs (for institutional safety requirements) and [NPR 8715.3](#), NASA General Safety Program Requirements (for mission assurance requirements), two types of relief may be requested: waivers and deviations. Both are written authorization to depart from a specific requirement. Waivers are granted after the requirement is put under configuration control, as defined during program/project lifecycle, at the level the requirement will be implemented. Deviations are granted before the requirement is put under configuration control at the level the requirement will be implemented.

Note 3: NASA cannot authorize relief from external requirements, such as Federal, state, or local regulations, voluntary consensus standards incorporated by reference in Federal regulations, or NASA standards approved as alternate or as supplementary to a Federal standard. Requests for relief from a Federal, state, or local safety regulation will follow the review process in this chapter, will be reviewed by the NASA Headquarters Office of Safety and Mission Assurance, and will be submitted by the Designated Agency Safety and Health Official to the appropriate Federal, state, or local agency for approval.

Note 4: Requests for relief made by a NASA program/project residing on KSC which does not have any KSC institutional impacts (e.g., risk to KSC personnel/property) will be processed in accordance with that NASA program/project's request for relief process. Requests for relief from contractor-imposed safety requirements will be processed by contract management and are outside the scope of this request for relief process.

b. This section shall be used to request relief from SMA requirements contained in the following:

- (1) NASA KSC requirements documents (e.g., KNPR)
- (2) NASA HQ procedural requirements documents and required standards (e.g., NPR, NASA Standard)
- (3) Other Federal Agency documents

c. When the unmet requirement(s) resides in both a Center and a higher-level safety document, the request for relief shall be generated against the requirement in the higher-level document.

d. Request for relief shall be processed prior to the time when the stated requirement will not be met.

2.1 APPROVAL AND RISK ACCEPTANCE AUTHORITIES

2.1.1 APPROVAL AUTHORITY

- a. When the Chief, SMA delegates request for relief approval authority in [NPR 8715.1](#) and [NPR 8715.3](#), the Center Director further delegates approval authority to the NASA KSC Director of SMA.
- b. When approval authority for requests for relief are delegated to the NASA KSC Director of SMA, the NASA KSC Director of SMA may delegate approval authority to the Program Chief Safety and Mission Assurance Officer (CSO).

2.1.2 RISK ACCEPTANCE

- a. As required in [NPR 8715.1](#) and [NPR 8715.3](#), the director of the appropriate KSC directorate or the Center Director (as appropriate) will be the risk acceptance authority for Center-specific risks associated with the request.

Note: The level or risk acceptance will be based on the level of risk identified. Entities requesting relief should work with the appropriate SMA organization to determine the appropriate level.

- b. As required in [NPR 8715.1](#) and [NPR 8715.3](#), the Program/Project Manager will be the risk acceptance authority for program/project risks associated with the request.

2.2 REVIEW AND CONCURRENCE REQUIREMENTS

- a. All requests for relief shall be reviewed by and receive a concurrence or nonconcurrence from:

- (1) The delegated Center Safety Manager
- (2) The appropriate NASA KSC SMA Division Chief(s).
- (3) The Director(s) of the affected NASA KSC directorate(s).
- (4) Director (KSC Directorate equivalent or higher) of each affected non-NASA organization.

- b. Requests for relief shall be reviewed by and receive a concurrence or nonconcurrence from the identified Institutional Safety Discipline Lead when involving:

- (1) Fire Protection and Life Safety – Authority Having Jurisdiction (AHJ)
- (2) Explosives, pyrotechnics, and propellants – Explosives Safety Officer (ESO)
- (3) Fall Protection - Fall Protection Program Administrator (FPPA)
- (4) Cranes/lifting devices – Lifting Devices and Equipment Manager (LDEM)

- (5) Pressure vessels (ground fixed and mobile) – Pressure Systems Manager (PSM).
- c. Requests for relief that impact the KSC Institution shall be reviewed by and receive a concurrence or nonconcurrence from the Ground Risk Review Panel (GRRP) Chair.
- d. SMA requests for relief from requirements with an approval authority other than the KSC SMA Director shall be reviewed by and receive a concurrence or nonconcurrence from the KSC SMA Director.
- Note: If the NASA KSC Director of SMA has been delegated approval authority, there is no need for a concurrence or nonconcurrence.*
- e. Requests for relief that impact the program/project shall be reviewed by and receive a concurrence or nonconcurrence from the:
- (1) Program/Project Manager
 - (2) Program CSO
- Note: If the Program CSO has been delegated approval authority, there is no need for a concurrence or nonconcurrence.*
- f. Requests for relief that impact a non-NASA organization will be sent to the Contracting Officer to provide awareness.
- g. The President of the NASA KSC American Federation of Government Employees (AFGE) Union shall be notified for review and signature.

Note: The AFGE Local 513 should address any concerns to the GRRP.

2.3 REQUEST FOR RELIEF PROCESS REQUIREMENTS

- a. Requests for relief shall include documented risk management techniques and risk assessments to provide those in a position to approve/deny the request for relief with the necessary information to make an informed decision.
- b. Requests for relief shall include a risk matrix with defined probability (likelihood) and consequence (severity) categories.
- Note: The risk assessment process is a principal factor in the understanding and management of risk. Use of the risk matrix ensures that hazards are identified and resultant risks are assessed by considering probability of occurrence and severity of consequence. The [KSC Risk Management Scorecard](#) may be used as a reference tool.*
- c. Requests to amend waivers/deviations or extend the duration of waivers/deviations that have previously been approved shall be evaluated by the Request for Relief Coordinator on a case-by-case basis.
- Note: The Request for Relief Coordinator will coordinate the review of the request for amendment. The level/extent of approval required will be based on the scope of the change.*

d. When the review of the request for relief and the associated risk assessment results in a nonconcurrency, the reviewer shall provide detailed rationale for the nonconcurrency recommendation.

Note: The request for relief can continue through the process even if there are nonconcurrences. It is the responsibility of the approval authority and the risk acceptance authority to decide if they will approve/accept the request for relief with the documented nonconcurrences.

2.4 REAL TIME OPERATIONAL CONSTRAINTS

a. In the case of off-shift/real-time requirement relief requests against KSC or NASA-level requirements, the operating organization submitting the request (contractor or NASA) shall obtain, as a minimum, required risk assessments, approval from the appropriate NASA KSC S&MA lead official (may be verbal), and review and final risk acceptance (may be verbal) from the appropriate senior NASA KSC program/project or directorate organization official.

b. The senior NASA management official at the worksite shall make a reasonable attempt to contact the local NASA KSC management officials who would be involved with a nominal waiver request.

c. The NASA operational lead shall personally document this verbal concurrence prior to implementation and the person providing the verbal approval must sign the documentation at the earliest reasonable time.

d. The real-time documentation of approval and acceptance shall be kept as part of the permanent record of the waiver.

e. The operating organization submitting the request shall document the request, approvals, and how the approvals were obtained real-time within 24 hours or by the end of the next regular business day.

f. During time critical operations (e.g., terminal launch countdown), requests for relief may be approved on a recorded net. This approval will include a discussion of the risk assessment. Completion of the approved requirement relief request application shall follow within 24 hours or by the close of business on the next regular business day.

2.5 REQUEST FOR RELIEF RECORDKEEPING/FOLLOW-UP

a. The SMA Request for Relief Coordinator will maintain a copy of all relief requests and will send a copy to OSMA as required.

b. The operating organization who submitted the request for relief shall be responsible for implementation and maintenance of procedural and operational controls specified as requirements by the request for relief, and for their own closed-loop tracking.

c. The appropriate NASA KSC SMA Division shall track the implementation through surveillance activities.

CHAPTER 3: WORKPLACE SAFETY REQUIREMENTS

3.1 GENERAL CONTROLS

- a. Personnel entering facilities/processing areas with grate flooring shall wear shoes that cover the entire foot, are closed-toe, and which have no heels or low, wide heels that do not pose a tripping/walking hazard.
- b. Personnel working in or visiting areas where hazardous operations occur shall be prohibited from wearing headphones/earphones with personal, portable electronic devices since these items hinder the ability to hear emergency/evacuation announcements.
- c. Personnel shall not enter a control area unless authorized to do so by the appropriate area access controlling authority.
- d. While hazardous operations are being conducted or hazardous conditions are present, persons incapable, without the assistance of others, of ascending or descending ladders or stairs within both the direct or alternate evacuation routes from the hazardous facility shall not be permitted access requiring such ascent or descent.
- e. Personnel working near operating rotating machinery shall:
 - (1) Not wear gloves, identification badges, rings, and other jewelry.
 - (2) Wear only "break away" lanyards.
 - (3) Restrain long hair, neck-ties, and lanyards to avoid becoming entangled in rotating machinery.
- f. Organizations conducting tours in or around KSC-operated facilities for non-operational personnel shall:
 - (1) Develop a tour plan that addresses safety.
 - (2) Obtain approval from NASA KSC SMA on the tour plan.
 - (3) Conduct all tours in accordance with the tour plan.

Note: All KSC visitor tours will be scheduled through the Communications and Public Engagement directorate.
- g. Roofs where OSHA-compliant safety controls are not in place shall:
 - (1) Have restricted access.
 - (2) Be placarded with a description of why it is restricted and a point-of-contact for access.

3.2 LIGHTNING REQUIREMENTS

3.2.1 BACKGROUND INFORMATION

a. KSC is located in a geographical area where significant lightning activity occurs. Operations involving personnel and sensitive equipment/hardware should be cognizant of the lightning hazard and have pre-planned mitigations established when a lightning hazard exists.

b. Weather advisories, including Phase I and Phase II notifications for lightning, are defined in the Air Force 45th Weather Squadron (45WS) Space Wing Instruction (SWI) 15-101, Weather Support, and have been tailored for KSC use in [Appendix A](#) of this directive. The Phase I Lightning Watch and Phase II Lightning Warning are designed and intended to notify personnel in specific high-density operational areas when a lightning hazard is approaching and when a lightning hazard is present.

When a lightning hazard is detected by weather forecasters, Phase I and Phase II announcements are made on the KSC Paging and Area Warning System (PAWS) and select KSC radio system voice nets to notify personnel in specific notification areas. These specific notification areas are hereafter referred to as "Lightning Hazard Notification Areas" (LHNA).

c. KSC has four LHNAs (depicted in [Appendix A](#)), each with a defined radius in nautical miles (nm). The following are the LHNAs at KSC:

- (1) Haulover (0.75 nm radius)
- (2) Shuttle Landing Facility (SLF) (1.75 nm radius)
- (3) Launch Complex 39 (LC39) Area (1.75 nm radius)
- (4) Industrial Area (1.75 nm radius)

d. Phase I and Phase II lightning notifications are intended to notify personnel working within an LHNA of the lightning hazard in order to implement pre-planned lightning safety plans or procedures for personnel and hardware. For work locations outside of the LHNAs, other methods of identifying and communicating the lightning hazard must be developed by the respective organization (see [section 3.2.2.2](#)).

e. A facility is considered to be lightning-protected when it complies with National Fire Protection Association 780 (NFPA 780), Standard for the Installation of Lightning Protection Systems.

3.2.2 GENERAL LIGHTNING REQUIREMENTS

a. Organizations shall provide reliable means to reduce the risk of personnel exposure to a lightning hazard.

Note: Inside of LHNAs where PAWS announcements are audible, Phase I and Phase II announcements together with the requirements in this document are a reliable means of reducing the risk to personnel. When PAWS lightning notifications are not reliable or when work locations are outside of the LHNAs, organizational safety plans and procedures must

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be implemented to reduce risk to personnel exposed to a lightning hazard (see [section 3.2.2.2](#)).

- b. Individuals shall act to protect themselves from the dangers of lightning.

Note: Personnel have the right to remove themselves safely from reasonably-perceived exposure to lightning. Personnel should remain cognizant of the lightning environment and seek shelter in an appropriate lightning-protected structure when on KSC property, including Kennedy Athletic Recreation and Social parks.

- c. Personnel shall not access or remain on rooftops or in exposed areas (outdoors) when a lightning hazard exists.

Note: Lightning protection systems and associated zones of protection are designed to protect facility systems and are not designed to protect personnel from lightning hazards.

- d. Personnel shall not commence the operation of electrical systems in non-lighting protected facilities or on the outside of any facility including electrical work across interfaces [e.g., mates and demates of flight and ground support equipment (GSE) umbilicals] when a lightning hazard exists.

- e. The operation of electrical systems in non-lighting protected facilities or on the outside of any facility, including electrical work across interfaces (e.g., mates and demates of flight and GSE umbilicals), shall be safely halted for the duration of the lightning hazard.

- f. Organizations shall incorporate lightning safety provisions into job hazard analyses (JHA), plans, and procedures to reduce the risk to personnel and, when appropriate, flight hardware and critical GSE.

Note: This includes the movement of flight hardware or critical GSE between facilities and propellant transfers. Plans or procedures should address lightning safety for work areas within LHNAs (where Phase I and Phase II notifications may apply) and outside of LHNAs (see [section 3.2.1.d](#)). For locations outside of the LHNAs, the JHAs, plans, or procedures should address the information in [section 3.2.2.2](#).

- g. Organizations shall develop and provide protective measures for ground operations and institutional activities that include exposure to lightning for personnel or equipment that may be subject to unacceptable damage or loss, including land vehicles (and land vehicle fueling), marine, and aircraft operations and maintenance.

3.2.2.1 Lightning Requirements within a Lightning Hazard Notification Area

- a. KSC lightning announcements (i.e., Phase I and Phase II) notify personnel within an LHNA of lightning hazards through PAWS. Organizations shall verify that their personnel are adequately notified.

Note: If personnel cannot hear PAWS announcements, then organizations must implement other methods to notify personnel of a lightning hazard. Alternate means of notification include but are not limited to text, email, and radio voice nets.

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b. During applicable Phase I Lightning Watches, task leaders and personnel shall prepare to safely halt any operations that will be affected if a Phase II Lightning Warning is announced for their LHNA.

c. Ongoing operations that expose personnel to the lightning hazard shall be safely halted as quickly as possible when an applicable Phase II Lightning Warning is announced.

Note: If inside a lightning-protected facility, operations may continue during Phase II except for work on systems connected to utility services capable of conducting currents which enter the structure from the outside. Work on such systems must cease. See section 6.3.5.

3.2.2.2 Lightning Requirements Outside of a Lightning Hazard Notification Area

a. Organizations shall incorporate lightning safety provisions into JHAs, plans, or procedures for work locations outside of an LHNA.

Note: This requirement is not intended to duplicate the operational assessment performed in [Chapter 6](#). Lightning safety controls developed as a part of the [Chapter 6](#) operational assessment should meet the intent of this requirement.

b. Lightning safety provisions shall address the following, at minimum:

(1) The process by which the organization, given the lightning safety controls available, determines if an operation that could expose personnel or sensitive equipment to a lightning hazard should commence.

Note: The process described should take into account the amount of time required for personnel to seek shelter or safe the operation and the amount of forewarning provided by the method of hazard detection. Personnel should be provided with adequate time to evacuate an area before the hazard occurs. For example, if personnel working on a communications tower require 20 minutes to descend the tower and seek shelter, but the detection method allows for only 10 minutes before the hazard is present, personnel may not have sufficient lead time to reduce their risk to the hazard.

(2) The preparations that will occur when a thunderstorm is approaching to halt safely any operations that would expose personnel or sensitive equipment to the lightning hazard.

(3) The procedures for halting ongoing operations that would expose personnel or sensitive equipment to the lightning hazard.

(4) The location where personnel in exposed areas or outdoors will shelter if a lightning hazard exists.

3.2.3 GENERAL FACILITY LIGHTNING REQUIREMENTS

a. Facility owners shall periodically inspect and maintain the facility lightning protection systems to ensure the lightning protection system meets the design intent of the facility.

b. For facilities that could be configured to create large openings (e.g., bay doors) which expose operations or personnel inside the facility to a lightning hazard, plans or procedures

shall be developed to mitigate the risk to personnel and equipment during a Phase II Lightning warning or when a lightning hazard exists.

Note: Potential mitigations could include closing large openings or evacuating the area.

3.2.4 LIGHTNING SAFETY ASSESSMENT COMMITTEE

In accordance with their charter, the Lightning Safety Assessment Committee (LSAC) will, at the request of any design organization, review the design or modification of any KSC facility lightning protection system and provide comments and recommendations as appropriate. The LSAC will also assess any facility, work area, or work activity for lightning safety when requested by any individual employee or organization. The LSAC will then brief the requestor on the assessed lightning risks to personnel, facilities, and systems, and provide recommended mitigations.

3.2.5 LIGHTNING PROTECTION OPERATIONAL REQUIREMENTS

- a. Requirements for electrical system operations and maintenance during lightning can be found in [section 6.3.5](#).
- b. Requirements for explosive, ordnance, and solid propellant operations during lightning can be found in [section 9.4](#).
- c. Requirements for crane operations during lightning can be found in [section 10.5](#).

3.3 PERSONNEL ACCESS TRAINING

- a. All permanently badged personnel shall take QF110KSC, KSC General Hazards Familiarization, and repeat the training at least every three years to satisfy the minimum safety training requirements for the Center.

Note: Completing QF110KSC, KSC General Hazards Familiarization, does not guarantee access to KSC access-controlled facilities/areas. Supervisors are responsible for identifying those individuals who need access to KSC access-controlled facilities/areas.

- b. If access control is required based on hazard assessment/controls developed and approved per the requirements of [section 4.1](#) of this document, the NASA organization area owner shall:

- (1) Provide a means to control access to KSC access-controlled facilities/areas via area access training or escorts.
- (2) Develop and maintain currency of unique area access safety training for operational facilities/areas not covered by QF110KSC, KSC General Hazards Familiarization.
- (3) Notify the NASA SMA Institutional Division of any required area access training.
- (4) Provide a POC for training for each facility to NASA KSC SMA, Institutional Division.
- (5) Make the area access training available to all personnel requiring access to the facility.

Note: Some area access control is electronic and some is local. It will be up to the NASA organization area owners to establish the means of access control required as the

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result of these two items. Every effort should be made by the area owners to include a physical walk-down of the hazardous controlled area, Personal Protective Equipment (PPE) locations, and marshalling area when requested. This is especially important for temporary employees not familiar with the area or facility.

- c. Each area access training course shall define the frequency at which refresher training is required.
- d. Personnel requiring entry to KSC access-controlled facilities/areas shall complete required area access training or be escorted by trained personnel.

3.4 MAXIMUM WORK TIME

3.4.1 GENERAL

a. Immediate supervisors shall be responsible for monitoring and maintaining accurate records of employees work hours and forecasting their work schedules to ensure maximum work time (MWT) requirements conformance.

b. Employees shall:

- (1) Have a minimum of 8 hours off duty between shifts.
- (2) Work no more than 16 consecutive hours unless a Program Declared Emergency (PDE)/Center Declared Emergency (CDE) are in effect.
- (3) Work no more than 18 consecutive days unless a PDE or CDE is in effect.

Note: PDE and CDE requirements are provided in [section 3.4.3](#).

c. Prior to allowing employees to exceed the following MWT limits, approval shall be obtained from the appropriate level of management, as defined in the table below, and all approval authorities should consider the human factors risk level before granting the following permissions to exceed MWT limits.

Table 1 Maximum Work Time Approval

Duration	Period	Approver/Approval Level
>12 hours	Consecutive	Supervisor
>16 hours	Consecutive	Directorate Head (or Contractor Equivalent)
>60 hours	7-days	Supervisor
>240 hours	4-weeks	Supervisor
>2500 hours	12-month, rolling	SMA Director
>7 days	Consecutive	Division Chief (or Contractor Equivalent)

d. At the end of the extension period permitting 14 to 18 consecutive days of work, the employee shall be given a minimum of 2 full days (48 hours) off.

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e. Specific operational/processing scenarios approved by the NASA KSC Director of SMA shall be exempted from the consecutive day limits since these scenarios are reasonably predictable/expected, and the nature of the work allows these limits to be exceeded without causing excessive employee fatigue.

f. Employees shall obtain the appropriate permission (as described above) each day a MWT limit is to be exceeded.

Example: If an employee has approval to work more than 60 hours, this approval is good only for the day on which 60 hours within a 7-day period is exceeded. Approval will be required for each additional day that the employee needs to work during the 7-day period.

g. Employees and supervisors encountering shift changes, time zone changes, and use of "non-standard," 5-day, 8-hour shift will follow the specific requirements in [NPR 1800.1, NASA Occupational Health Program Procedures](#).

3.4.2 MAXIMUM WORK TIME APPROVAL RECORD RETENTION

a. Approval (verbal, electronic, or written) shall be obtained prior to exceeding MWT limits.

b. All approvals shall be formally documented by close of business the next regular workday.

c. The formal documentation shall include the date, rationale (including consideration of risk), and required approvals, as defined above.

d. The approving organization shall maintain records of approvals and make them available upon request.

e. MWT records shall be retained for a minimum three-year period.

f. Division Chief (or contractor equivalent) shall report exceedances of these MWT limits to their Directorate Head (or contractor equivalent) in the manner specified by the Directorate Head (or contractor equivalent).

Note 1: Directorate Head (or contractor organizational director) should receive MWT exceedance report at least annually.

Note 2: If audits reveal that records are not being maintained properly, additional reporting may be required.

g. Directorate Head (or contractor organizational director) shall control and manage MWT limit exceedances by monitoring MWT data for trends to prevent system abuse.

h. The calendar year, week, and day (which changes at midnight) shall be used for work time evaluation and maintenance of accurate time records.

Note: Contractors may utilize business shift procedures to determine day start and stop times.

3.4.3 PLANNING FOR DEVIATION SURGES

During PDEs, program/project and organizational directors of affected organizations may approve in advance of an event/circumstance a large number of requests to exceed MWT limits.

- a. A PDE shall only be issued by a program/project or organizational director (or a designee) during a phase of planning when they determine that the task ahead exceeds the available resources for addressing the task within the MWT limits.
- b. The normal MWT approval and recording process described in [section 3.4.2](#) of this KNPR shall be required for exceedances during a PDE period.
- c. Exceeding MWT limits shall be acceptable when a CDE is issued.

Note: A CDE goes into effect by the authority of the Center Director (or designee) in the event of an emergency or a threat to the Center (e.g., natural disaster or terrorism).

3.5 MISHAPS AND CLOSE CALLS

3.5.1 GENERAL REQUIREMENTS

- a. Civil Servants and NASA contractors will meet the requirements of [NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping](#) and [KSC-PLN-2807, Mishap Preparedness and Contingency Plan](#).
- b. The requirements of this chapter, [KSC-PLN-2807, Mishap Preparedness and Contingency Plan](#), and program-specific Contingency Plans shall be used for the implementation of [NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping](#).

Note: [KSC-PLN-2807, Mishap Preparedness and Contingency Plan](#), contains the process for determining KSC mishap and close call notification, classification, interim response, reporting, investigation authority, corrective actions, and lessons learned.

- c. All mishaps and close calls shall be reported to the responsible supervisor and the organizational (NASA or contractor) safety office.
- d. All mishaps and close calls shall be investigated to determine the root cause(s), to develop and implement corrective actions to prevent recurrence, and to document and share lessons learned.
- e. All mishaps and close calls shall be entered electronically into the NASA Mishap Information System database.

3.5.2 SAFETY STATISTICS RECORD

- a. A Safety Statistics Record (SSR), KSC Form 6-22 NS, shall be completed no later than the fifteenth of each month by all KSC contractor, program/project, and directorate organizations and submitted to the KSC SMA Institutional Division for use in developing Center-wide safety metrics.

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b. If adjustments, corrections, or additions to a previous fiscal year's statistical data occur, an updated year-end SSR for the affected fiscal year shall be submitted.

3.5.3 TREND ANALYSIS

All KSC program/project or directorate organizations shall review the Center-wide safety metrics developed by the KSC SMA Institutional Division in order to identify trends requiring corrective or preventive actions.

3.5.4 KSC MISHAPS INVOLVING ONLY NON-NASA PERSONNEL OR PROPERTY

For mishaps that only affect personnel or property of organizations who are non-NASA KSC and who are not performing work under a NASA contract, the investigation and reporting process will be as specified and described in the appropriate written agreement. These mishaps will not be considered NASA KSC mishaps unless otherwise stated in the applicable contracts, grants, or agreements.

3.6 EMERGENCY EVACUATION REQUIREMENTS

a. If the location or nature of the emergency situation deviates from the nominal evacuation plan, public address system announcements shall be made during emergency evacuations to define the location and nature of the emergency and to specify evacuation exits, alternate routes, and fallback area/location.

Note: [Facility-specific plans for a nominal evacuation can be found in KSC Safety & Health section of Business World.](#)

b. The area (flashing red) warning lights and the evacuation/fire alarm system shall be activated, as appropriate.

c. Supervisors and task leaders of personnel working in areas with high noise or of personnel not within hearing range of public address speakers shall provide reliable alternative means to notify these persons of emergency evacuations.

d. In addition to the fire drills required by [NASA-STD-8719.11, Safety Standard for Fire Protection](#), section 11.5, emergency evacuation drills shall be conducted for each shift where ten or more employees commonly work.

Note: This requirement is within the purview of the KSC AHJ. Any interpretations will be addressed by the AHJ, and any requests for relief will go through the AHJ.

3.7 ELECTRICAL EXTENSION DEVICES

Electrical extension devices include extension cords, Relocatable Power Taps (RPTs), and other devices designed to extend electrical wiring from a permanent receptacle to a piece of electrical equipment.

Note: The requirements in this section are within the purview of the KSC AHJ. Any interpretations will be addressed by the AHJ, and any requests for relief will go through the AHJ. These requirements are KSC-specific, supplemental requirements, applicable in

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addition to the requirements already defined in [NASA-STD-8719.11, Safety Standard for Fire Protection](#).

- a. Every effort shall be made to avoid using extension devices. Moving of furniture, relocation of equipment, or installation of additional permanently wired electrical receptacles may help to eliminate the need for extension devices.
- b. Extension devices shall be listed or approved by a [Nationally Recognized Testing Laboratory](#) for their intended use.
- c. Extension devices for 120 VAC shall be three wire grounded, "Dead Front" type with adequate current carrying capacity, but in no case less than 14 AWG.
- d. Electrical extension devices shall not be used in combination (i.e., "daisy chained") where one extension device is plugged into another.

Note: The use of a single Ground Fault Circuit Interrupter (GFCI) pigtail or anti-restart protection plugs are excluded from this requirement.

- e. All uses of electrical extension devices shall be evaluated by a competent person (see definition), based on intended use, environment in which it is to be used, capacity of the service circuit, capacity of the device and cord/cable, and the physical condition of the extension device to ensure the device and electrical service is adequate for the demand.
- f. The use of electrical extension devices to provide power to meet temporary operational needs (e.g., use of electrical hand tools, heat lamps, lighting) for temporary use that is restricted to completion of a temporary job shall be permissible.
- g. All extension cords, with the exception of RPTs (i.e., power strips as described below), shall be unplugged when not in use.

h. RPTs

- (1) RPTs (i.e., power strips) with surge protection shall be permissible to protect electronic equipment such as computers, copiers, printers, fax machines, analytical instruments, and other critical electronic components from transient voltage surges.

Note: There is no time constraint regarding how long RPTs/surge protection devices may be used continuously in this capacity. These devices should be turned off or disconnected when not in use.

- (2) The use of RPTs shall be permissible as long as the RPT is not permanently installed/secured to building structures, tables, work benches, cabinets, or similar structures.

Note: An RPT would be considered "permanently secured" if tools are required to install or remove.

- (3) RPTs shall not be rewired in order to attach a longer cord.

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(4) RPTs shall only be permitted on construction sites when they are used in “office” environments (e.g., in construction trailers) to protect electronic office equipment such as computers, copiers, printers, and fax machines from transient voltage surges.

i. Ground Fault Circuit Interrupters

(1) Extension devices exposed or potentially exposed to wet environments shall be approved for use in wet environments, equipped with a GFCI, and be connected to a permanent electrical outlet.

(2) When using extension cords in combination with GFCI pigtails, the maximum rated load applied shall not exceed the rating of the GFCI pigtail.

j. Extension devices used in potentially hazardous or explosive atmospheres shall:

(1) Meet the National Electric Code standards for the appropriate class and division.

(2) Not be modified by the user.

k. Equipment power cords, extension cords, and other electrical cabling should be used in a manner that does not create a tripping hazard. If such placement is unavoidable, a protective cover (or equivalent) shall be placed over the cable and marked in such a manner as to alert personnel to the tripping hazard (e.g., black/yellow safety tape, brightly colored cones).

l. Extension cords run through doorways, windows, or similar openings shall be protected from damage.

m. For permanent structures, extension cords shall not be affixed to structures; extend through walls, ceilings or floors, or under doors or floor coverings; or be subject to environmental or physical damage.

n. For temporary structures (less than 30 days) like tents where permanent electrical installations are impractical:

(1) Flexible cords and cables shall be protected from accidental damage.

(2) Sharp corners and projections shall be avoided.

(3) Protection shall be provided to avoid damage where cords pass through doorways or other pinch points.

o. In areas where vehicles might run over the extension device, a protective cover/bridging device with brightly colored cones designating the hazard shall be used to reduce the possibility of damage to the extension device.

p. Electrical appliances (e.g., coffee pots, toasters, cappuccino makers, microwave ovens, refrigerators) shall be plugged directly into an electrical receptacle or into a power strip with integrated circuit breaker (15A or less) that is plugged directly into an electrical receptacle.

Note: Electrical extension devices (including power strips not identified in the requirement) may not be used between the receptacle and the electrical appliance.

3.8 DANGER TAGS

a. All defective or nonconforming equipment that presents a threat of death or serious injury to personnel or destruction of flight hardware or equipment shall be identified by KSC Danger Tag, KSC Form 20-165.

Note: KSC Form 20-195 LOTO tag is not to be used as a substitute for KSC Danger Tag, KSC Form 20-165.

b. Each organization issuing Danger Tags shall maintain accountability through the use of a log for all issued and returned tags.

c. Each organization using Danger Tags shall conduct an annual audit of the Danger Tag program.

3.9 USE OF ELECTRONIC EQUIPMENT

a. Organizations who wish to use radio frequency (RF)-emitting devices in explosives locations or facilities shall obtain the approval of the KSC Explosives Safety Officer (ESO).

Note: Provide the ESO with the RF safe separation distances between Electroexplosive Devices (EED) and the transmitting antenna of the RF-emitting device as calculated per [NASA-STD-8719.12, Safety Standard for Explosives, Propellants, and Pyrotechnics](#), Table V: Recommended EED Safe Separation Distances and Power Densities.

b. Organizations requesting KSC ESO approval of an RF-emitting device shall also provide the KSC ESO with the brand, model, and serial number of all RF-emitting devices that will be used in explosives locations or facilities.

c. RF-emitting devices shall not be used within 25 feet (established using Figure 5 of [NASA-STD-8719.12, Safety Standard for Explosives, Propellants, and Pyrotechnics](#)) of the following:

- (1) Exposed explosives or pyrotechnics.
- (2) Unshielded electro-explosives.
- (3) Unshielded electrically initiated devices.

CHAPTER 4: TOPIC-SPECIFIC WORKPLACE SAFETY REQUIREMENTS

4.1 LOCKOUT/TAGOUT PROGRAM

Lockout/Tagout (LOTO) is the process of configuring equipment in a temporary condition in which the unexpected release of energy is prevented from endangering personnel performing servicing or maintenance tasks.

- a. Personnel involved in LOTO shall shut down equipment per appropriate instructions established for that machine or equipment.
- b. Personnel involved in LOTO shall notify affected third parties prior to shutting down and locking out a system that may affect those parties.
- c. Authorized employees shall use a metered device to ensure a zero energy state for all electrical LOTO.

4.1.1 LOCKOUT/TAGOUT DEVICES

OSHA requires the use of tags as warning devices to alert personnel of the LOTO status, but tags do not provide physical restraint to prevent a device from being activated. Physical restraint is provided by locks. OSHA requires the use of locks in all LOTO situations where it is physically possible to attach a lock.

- a. Prior to performing an activity at KSC that requires LOTO where it is not physically possible to attach a lock to a device being locked out, a procedure shall be written to explain why it is not physically possible to apply a lock and to define how the hazards will be isolated in the absence of a lock.
- b. Each Authorized Employee (as defined in [section 4.1.3.1](#)) shall be issued locks, tags, multiple lock hasps, or other LOTO devices as deemed necessary, either individually or in a kit form (e.g., centralized locker) by his or her supervisor or designee.
- c. Locks shall be identified using KSC Form 20-195a (Lockout Identifiers).
- d. Only KSC Form 20-195 shall be used as the LOTO tag.
- e. Only Authorized Employees trained in LOTO shall be permitted to apply KSC Form 20-195 and Form 20-195a.
- f. KSC Form 20-195 shall not be used for any other purpose other than LOTO.
- g. In addition to attaching KSC Form 20-195 to the lock hasp, KSC Form 20-195a shall also be attached directly to the lock as a unique identifier.

4.1.2 LOCKOUT/TAGOUT DEVICE REMOVAL

In situations where the Authorized Employee is not available to remove LOTO devices, it shall be permissible to remove the LOTO device under the direction of the Authorized Employee's supervision provided that all of the following conditions are met:

- a. At least one attempt is made to contact the Authorized Employee who applied the device(s) to verify they are not available to remove the device(s).
- b. The Authorized Employee's supervisor and another Authorized Employee are present.
- c. The Authorized Employee's supervisor and the other Authorized Employee agree that it is safe to start the equipment/machinery prior to removing the LOTO device.

Note: In cases where a lock has to be removed without the knowledge of the Authorized Employee who applied the device, OSHA regulation 1910.147(e)(3)(ii) requires that the Authorized Employee be notified that the LOTO device(s) have been removed prior to their return to work.

4.1.3 LOCKOUT/TAGOUT TRAINING

4.1.3.1 General Requirements for Affected and Authorized Employees and Supervisors of Personnel Participating in LOTO

Authorized Employees are those who service or maintain equipment and perform LOTO procedures. Affected Employees are those who operate or use the equipment being serviced or maintained or others in the area where equipment is locked or tagged out.

- a. Training shall be conducted and documented for all Affected and Authorized Employees to include their direct supervisor.
- b. Affected and Authorized Employees shall receive initial training or instruction in LOTO to ensure that the purpose and function of the LOTO (energy control) program are understood.
- c. The employer shall ensure Affected and Authorized Employees acquire the knowledge and skills required for the safe application, usage, and removal of the energy controls.
- d. Affected and Authorized Employees shall be trained in LOTO requirements in accordance with their assigned (or designated) level of responsibility.
- e. The employer shall certify that Affected and Authorized Employee training has been accomplished and is current.
- f. The certification shall contain each Affected and Authorized Employee's name and dates of training.

4.1.3.2 Training Requirements for Authorized Employees

- a. As required by 29 CFR § 1910.147(c)(7)(i)(A), training for Authorized Employees will ensure that these employees are able to:

- (1) Distinguish the various types of hazardous energy sources.
- (2) Identify the hazardous energy sources present in the workplace.
- (3) Understand dangers presented by workplace energy sources.
- (4) Understand and follow workplace LOTO procedures.

b. Authorized Employees shall receive LOTO retraining at least every three years.

4.1.3.3 Training Requirements for Affected Employees

Training for Affected Employees shall ensure that these employees are able to recognize when LOTO procedures are being implemented and understand the purpose of LOTO procedures and the importance of not attempting to startup or use equipment/machinery that has been locked or tagged out.

4.1.3.4 Training Requirements for Other Employees

Based on requirements from 29 CFR § 1910.147(c) (7)(i)(C) and § 1910.147 (c)(7)(ii), all other employees who may have reason to enter or work in the area where LOTO may be implemented shall be (1) instructed regarding the purpose of LOTO procedures, and (2) informed of the prohibition against restarting or re-energizing equipment that is locked or tagged out.

4.1.4 RECORDKEEPING/DOCUMENTATION

a. Organizations shall maintain inventory records of locks and tags.

b. Inventory lock records shall include:

- (1) Number of locks on hand.
- (2) The serial number of the locks issued to the employee.
- (3) Issued person's name.
- (4) Lock numbers lost or destroyed.

c. Tag control records shall include:

- (1) Numbers of tags received (lot numbers).
- (2) Tag numbers issued to employees.
- (3) Tags issued to specific shops or facilities (if applicable).
- (4) Numbers of tags lost or destroyed.

4.2 EMERGENCY EYEWASH AND SHOWER REQUIREMENTS

- a. The Emergency Eyewash and Shower Equipment (EE&SE) on KSC shall comply with American National Standards Institute (ANSI)/International Safety Equipment Association Z358.1 (latest revision).
- b. Inspections performed per ANSI requirements shall be documented on KSC Form 20-202, KSC Emergency Eyewash/Shower Inspection, and affixed to the unit where practical.
- c. Prior to the commencement of operations that require the use of EE&SE, all EE&SE shall be verified operational, including verification that the path to the EE&SE is unobstructed and that the inspection is current.
- d. In addition, prior to the commencement of operations that require the use of portable or self-contained EE&SE, it shall be verified that the EE&SE has not been tampered with or activated since the most recent inspection.
- e. EE&SE that are nonoperational, noncompliant with ANSI, or in unoccupied facilities shall be tagged out ([KSC Form 50-260, Notice Temporarily Out of Service Tag](#)).
- f. Operations that require the use of EE&SE that have been tagged out shall not be conducted.
- g. Eyewashes that are tagged out for over a year shall be approved by KSC SMA Institutional Safety Engineering and Assurance Branch prior to reinstatement.

4.3 FALL PROTECTION

The requirements in [KSC-STD-S-0033, KSC Fall Protection Standard](#), shall be met.

CHAPTER 5: SYSTEM SAFETY REQUIREMENTS

a. The hazard analysis process is integral to identifying and understanding hazards in order to characterize and mitigate/control risks. All operations that do not fall under laboratory operations or facility assurance analyses ([NPR 8715.3, NASA General Safety Program Requirements](#)) shall meet the following requirements.

b. Program/project or directorate organization (and their associated contractors) shall ensure proactive hazard analyses are performed throughout the program/project lifecycle (i.e., design, test, operations).

Note: Operational program/project developed controls will also be developed and approved according to [section 6.1](#) of this KNPR.

c. Procedures involving system safety and reliability analysis for NASA Civil Servants and for NASA Contractors (as applicable per contract) shall follow the methodology defined in [KNPR 8700.2, KSC Systems Safety and Reliability Analyses Methodology Procedural Requirements](#).

d. Program/projects or directorate organizations (and their associated contractors) shall ensure:

(1) Hazards that can jeopardize the ability to meet safety requirements have been identified.

(2) System safety and mission success risks are identified and documented early in the program/project lifecycle, and the status of these risks are updated throughout the program/project lifecycle.

(3) Feedback is provided throughout the system design and development process to permit the development of inherently safe designs.

Note: An inherently safe design is one that avoids hazards instead of controlling them, particularly by being fault tolerant, reducing the amount of hazardous material, or reducing the number of hazardous operations.

(4) Operations analysis begins in the system design phase to identify and mitigate any hazards (e.g., operational, processing, integrated) and any human factor issues (including human error).

(5) The probability (likelihood of occurrence) and undesirable consequence (severity) resulting from hazardous conditions are determined in order to document the risk.

Note: A graded approach to establish the robustness of methods used in determining the probability should be utilized. A graded approach to analysis requires that the resources and depth of analysis is commensurate with the consequences and the complexity of the decision situations being addressed.

(6) Valid and verifiable hazard controls are established, implemented, and tracked in a closed-loop system.

(7) Provisions have been made for management of risks.

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(8) Contractors develop and maintain a list of all systems and equipment for which they have contractual system safety and reliability engineering responsibility. This list shall include the type and level of system safety and reliability analysis performed or required to be performed.

e. Hazards shall be mitigated according to the following order of precedence:

- (1) Eliminate hazards.
- (2) Design for minimum hazards (including uncertainty reduction).
- (3) Incorporate safety devices to control the hazard.
- (4) Develop and implement special procedures.

f. All pertinent details of the hazard analysis and review shall be traceable throughout the initial identification of the hazard, any updates to the analysis, and hazard resolution (i.e., until the accepted mitigation is verified SMA).

CHAPTER 6: OPERATIONAL REQUIREMENTS

6.1 ASSESSMENT

a. Each operating organization shall:

(1) Establish a process to ensure identification and management review and acceptance of risk.

(a) This identification process shall include SMA working in concert with the operating organization, details responding to Institutional and relevant program requirements, and involvement of the appropriate SMA Technical Authority.

(b) Institutional risks that meet the KNPR 8700.2, Table A criteria for GRRP approval, and which are not under the purview of a program, shall be elevated to the GRRP.

Note: The GRRP has the discretion to delegate the authority of ensuring Institutional review and acceptance of low probability risks. This delegation will need to be documented or approved prior to implementation.

(c) Programs/projects operating at KSC shall establish agreements with the Institution for program/project risks having Institutional impacts.

(2) Perform an assessment to identify and evaluate all safety hazards associated with operations to be performed.

Note: Health hazards are addressed in [KNPR 1820.3, Hearing Loss Prevention Program](#), [KNPR 1820.4, Respiratory Protection Program](#), and [KNPR 1840.19, Industrial Hygiene Programs](#).

(3) Establish controls for the identified hazards, address all of the Center-mandated hazard controls identified in [section 6.2](#), and address all applicable hazard-specific controls identified in [section 6.3](#).

Note: [Appendix D](#) contains hazards/controls that the reviewing division will look for in their reviews of assessments.

(4) Operations performed in accordance with KSC-PLN-2322 Laboratory, Shop and Test Facility Management Plan shall utilize KDP-KSC-P-5458 Capabilities Determination Process to identify, assess, document and control safety and health risks and hazards. The Safety and Health Review Board (SHRB) will make determinations as to the required level of hazard analysis, hazardous classification, and need for documented procedures.

b. Documentation detailing the concept of operations, the identification and evaluation of all hazards associated with the operations, and the hazard controls established for each hazard shall be coordinated with the appropriate NASA SMA Division.

c. NASA SMA approval shall be obtained prior to start of operations or introduction of the hazard to the Center, whichever is first.

Note: The level of NASA SMA approval will be determined by NASA SMA and based on the risk level of the operations.

- d. When changes are made to hazardous evaluations or controls that have already been approved by NASA SMA, the operating organization shall submit the changed hazardous evaluation for re-approval.
- e. Prior to SMA approving the start of operations or introduction of a new hazard to the Center, the appropriate NASA SMA Division shall ensure:
 - (1) Hazard evaluations are adequately performed.
 - (2) Controls are established and verified to be adequate to protect personnel and property.
 - (3) Risks have been approved and accepted by the appropriate Management and SMA Technical Authorities in accordance with [section 6.1.a](#).

6.2 CENTER-MANDATED HAZARD CONTROLS

All of the Center-Mandated Hazard Controls shall be included in the assessment required in [section 6.1](#) of this document.

6.2.1 CONTROL AREAS

- a. An assessment shall be performed to determine the appropriate control area for each hazardous operation.

Note: The assessment should account for the type of operation and the location where it will take place, the hazard potential, and the proximity of people and other hardware. Guidelines are provided in Chapter 4 of [KSC-UG-8715.3, KSC Safety User's Guide](#).

- b. The control areas shall be re-evaluated when there is a change to the hazardous operation.
- c. Hazardous operations control areas shall not overlap the control area of another hazardous operation.
- d. Control areas shall be established to allow facility ingress and egress of personnel not involved with the operation.
- e. Control areas shall be established to allow emergency responders to access an emergency within the facility without requiring them to proceed through another operational cleared/control area.
- f. Control areas shall be installed and clearly marked to indicate the control boundary.
- g. Only the organization that installed the control boundary shall remove or alter the control boundary.
- h. Organizations removing the control boundary shall obtain safety concurrence prior to removing the control boundary to verify that the hazards are appropriately removed before the area is reopened.

- i. Personnel shall not enter an area that is posted with a radiation warning sign or barrier unless specifically authorized to do so by the radiographer responsible for the area.

Note: For radiation controlled areas, the controlling authority is the radiographer responsible for the area. As applicable to control areas, NASA SMA enforces, but does not establish or interpret, the Radiation Program's requirements contained in [KNPR 1860.1, KSC Ionizing Radiation Protection Program](#), [KNPR 1860.2, KSC Nonionizing Radiation Protection Program](#), and as specified in the user organization's Radiation Use Authorization.

6.2.2 PERSONNEL ACCESS LIMITATIONS

Chapter 4 of [KSC-UG-8715.3, KSC Safety User's Guide](#), contains guidelines to establish personnel access limits to a control area. The format of this assessment is at the discretion of the user organization, but the assessment should address essential personnel, area structural capabilities, rescue capabilities, ergonomics, and means of egress/capability of egress. If the assessment involves work in compartments, the assessment should also address work environment and air quality. Established manloading limitations are considered the maximum safe manloading for optimum conditions. Conditions of less than optimum are to result in manload decreases.

6.2.2.1 Limitations for Hazardous Operations Control Areas

- a. Personnel access limits shall be established and controlled by the operating organization for each hazardous operation's control area.

- b. Access to control areas shall be restricted to essential personnel.

Note: Hazardous operations should expose the minimum number of people, to the smallest quantity of hazard for the minimum period of time.

- c. The number and functions of personnel required to perform a hazardous operation shall be defined in the applicable documented procedure, stating the total number of personnel (including a safety professional), identifying individuals by call sign/functional title, and the organization or contractor employing each individual.

- d. Personnel access limits shall be re-evaluated when there is a change to the hazardous operation.

6.2.2.2 Hazardous/Nonhazardous Manloading Limitations of Compartments

- a. Safe manloading limits shall be established and controlled by the operating organization for each compartment.

- b. Manloading limits shall be re-evaluated when there is a change to the condition of the compartment.

6.2.3 SAFETY WARNINGS

Flashing safety warning lights, warning signs, and public address systems shall be installed at the control point in work areas or facilities where hazardous operations exist as a part of routine work.

6.2.3.1 Warning Lights

Warning light designations at KSC shall be:

- a. Flashing red: A danger period exists and personnel shall be cleared from the control area immediately.
- b. Flashing amber: A hazard period exists and entry to the control area shall be limited to essential personnel.

6.2.3.2 Warning Signs

Warning signs will be used in conjunction with and adjacent to warning lights as follows:

- a. Warning signs adjacent to red lights shall read as follows and may contain more specific response instructions:

**EMERGENCY SITUATION EXISTS
CLEAR AREA IMMEDIATELY**

- b. Warning signs adjacent to amber lights shall read as follows and may contain more specific response instructions:

**ENTRY ON CONTROLLED BASIS
HAZARDOUS MATERIALS/OPERATIONS PRESENT
ESSENTIAL PERSONNEL ONLY**

6.2.4 PUBLIC ADDRESS ANNOUNCEMENTS

- a. Public address announcements (or other positive means) shall be employed to alert those potentially exposed to hazards of danger and to provide information associated with hazardous operations.
- b. Announcements to clear the affected area immediately may be preceded by a high-pitched warbling sound designated by KSC.

6.2.5 BUDDY SYSTEM

All hazardous operations shall require the buddy system (defined in [Appendix A, Definitions](#)).

6.2.6 HAZARDOUS OPERATIONS SUPPORT REQUIREMENTS

- a. All hazardous operations shall have continual communications between the operation's control point and the operation.
- b. Hazardous operations shall be stopped and rendered safe if communication is lost.

6.2.7 SAFING OR SECURING HAZARDOUS OPERATIONS

All hazardous operations that utilize electrical power for safing or securing shall have emergency / back up power capable of safing the system.

6.2.8 PRETEST AND PRETASK BRIEFINGS

- a. A pretest briefing is required for integrated hazardous operations that require a major control area. The pretest briefing shall be held within 72 hours (96 hours in the event of a Center-wide 3-day weekend) prior to the start of the operational or control sequences of a documented procedure.
- b. A pretask briefing shall be performed prior to all hazardous sequences within a documented procedure.
- c. If shift change occurs prior to the completion of the hazardous sequence, then the briefings for the remaining tasks shall be repeated for the relieving employees.
- d. The following items shall be addressed in pretask briefings:
 - (1) Training, certification, and preparedness of operators, as required
 - (2) Specific hazards to which personnel will be exposed
 - (3) Safety protective equipment
 - (4) Emergency alarms
 - (5) Evacuation routes
 - (6) Emergency instructions
 - (7) Emergency Procedures Documents (EPDs)
 - (8) The specific revision of documented procedures to be used

6.2.9 SAFETY INSPECTIONS AND WALKDOWNS

- a. The operating organization shall perform the following safety inspections and walkdowns for their assigned work area(s):
 - (1) Safety inspections shall be performed immediately prior to the start of hazardous operations.

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Note: Additional inspections may be performed prior to the operation to allow time to resolve issues while remaining on schedule.

(2) Safety inspections shall ensure that there is a safe work environment and that the system/equipment is in proper configuration.

(3) Readiness inspections shall be accomplished and documented for areas/facilities/systems that have undergone construction or modification work which changes configuration or hazards involved in the process.

b. Prior to start of hazardous steps/sequences:

(1) Any identified discrepancies from the inspections shall be dispositioned or resolved.

(2) All hazard controls shall be in place.

6.2.10 TOOLS, EQUIPMENT, AND LOOSE ITEMS

All tools and equipment shall be tethered or secured when there is the potential for personnel injury or hardware/equipment damage.

6.2.11 DOCUMENTED PROCEDURES

Documented procedures identify and direct work to be performed, provide detailed instructions necessary to accomplish the intended task, and are to be followed step-by-step unless otherwise permitted in this chapter. The use of documented procedures ensures an organized and systematic approach for performing work and to identify and control hazards.

a. Documented procedures shall be required when either of the following are true:

(1) An operation is hazardous per the classification requirements in [Section 6.2.11.1](#) of this KNPR.

Note: Excludes operations under the Safety & Health Review Board (SHRB).

(2) An operation is of significant scope and complexity, and as a result, requires detailed control and mitigations in order for the operation to be performed successfully and safely.

b. Based on the assessment completed per [Section 6.1](#) of this KNPR, the operating organization shall classify all documented procedures as hazardous or nonhazardous.

6.2.11.1 Classification of Hazardous Procedures

Documented procedures that shall be classified as hazardous include but are not limited to operations involving or controlling activities that:

a. Require personnel to enter a work area with atmospheric conditions that could exceed occupational exposure limits or contain an oxygen deficient or enriched environment but which does not meet the [KNPR 1840.19, KSC Industrial Hygiene Program](#), definition of a "confined space."

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- b. Involve the handling, receipt, storage, transportation, installation, removal, checkout, or closeout of explosives including solid propellants.
- c. Involve liquid propellant loading, unloading or flow, venting, sampling, connecting or disconnecting, moving or storing of loaded storage units, or opening of contaminated systems.
- d. Involve cryogenic loading, unloading or flow, venting, sampling, connecting or disconnecting, moving or storing of loaded storage units, or repairing of a system containing cryogenics.
- e. Involve the handling or transfer of hazardous fluids, hazardous gases, combustible/corrosive liquids, or other hazardous materials when the given quantity of the gas/vapor or liquid, when mixed or unmixed with air, could result in death or serious physical injury.
- f. Involve "critical lift operations" as defined in [NASA-STD-8719.9, Lifting Standard](#).
- g. Involve the use of ionizing or non-ionizing radiation sources that have hazard controls specified in the approved Radiation Use Authorization for that source as issued by the KSC Radiation Protection Program.

Note: Use of a source covered by a General Use Authorization per KNPR 1860.1 or KNPR 1860.2 does not require classifying an operation as hazardous.

- h. Involve energized electrical systems that may expose personnel to injury and/or death. Exposure to energized electrical systems operating at voltages of less than 30 volts alternating current (AC) or 50 volts direct current (DC) may be considered non-hazardous if an assessment has been performed to verify the current levels will not result in a shock.

Note: Work involving energized electrical systems requires an energized electrical work permit as defined by NFPA 70E.

- i. Call up hazardous step(s) of subtask Documented Procedures. The controlling documented procedure shall be classified as hazardous.
- j. Involve the pressurization of systems or components and include at least one of the following cases:
 - (1) Flight system pressure vessels controlled by fracture mechanics.
 - (a) Any pressurization that exceeds any previously recorded pressurization in the pressure vessel operational time/ cycle log.
 - (b) Any pressurization above the Maximum Allowable Working Pressure (MAWP).
 - (c) Any pressurization greater than 25 percent of the MAWP when the vessel contains hazardous fluids.
 - (2) Flight system pressure vessels not controlled by fracture mechanics with:

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- (a) Any pressurization greater than 25 percent of the MAWP that exceeds any previously recorded pressurization in the pressure vessel operational time/cycle record log.
 - (b) Any pressurization above MAWP.
 - (c) Any pressurization greater than 25 percent of the MAWP when the vessel contains hazardous fluids.
- k. Involve the pressurization of ground-based pressure vessels/systems and include at least one of the following cases:
- (1) Any pressurization above the MAWP/Design Pressure.
 - (2) First time pressurization to rated pressure of any new vessel/system or the modified portion of an existing vessel/system. This excludes pressurization after removal or replacement of a component with a like item that has been pressure tested prior to installation. This also excludes pressurization of flexhoses up to rated operating pressure, provided hose restraints required by [section 7.8](#) of this KNPR are in place.
 - (3) In-place calibration at more than 80 percent of full scale for pressure gauges with scale range over 200 pounds per square inch gauge (psig) unless the gauge has a solid front case with pressure relief back.
 - (4) Involve procedures that manually control pressurization of systems where MAWP/Design Pressure can be reached.
- l. Involve the pressurization of Composite Overwrapped Pressure Vessel (COPV) to pressures greater than one-third of the COPV design burst pressure.

6.2.11.2 Content Requirements for All Documented Procedures

- a. The classification of the procedure per [section 6.2.11.1](#) (either “Hazardous” or “Nonhazardous”) shall be clearly marked on the cover page (or equivalent for electronic documented procedures).
- b. Specific hazards to which personnel will be exposed shall be identified.
- c. Steps/controls in documented procedures that are derived from hazard reviews/analyses shall be uniquely identified.

Note: Uniquely identifying these steps/controls ensures that hazard controls identified during the analyses are implemented and tracked in a closed-loop system.

- d. WARNING/CAUTION notes shall be provided immediately preceding the procedural step/series of related steps that directs a hazardous activity.

Note: For multiple steps for related work within a documented procedure, the above is only implemented for the first step that requires the safety precautions.

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- e. Tools, equipment, clothing, or any other PPE required for the safe performance of the operation or as required by emergency procedures associated with the operation shall be identified.
- f. All safety, health, and emergency response organizational elements required to support the operation shall be identified.
- g. Any emergency instructions other than or in addition to those in the EPD shall be:
 - (1) Included in (or referenced by) a documented procedure.
 - (2) Available to all individuals involved in the performance of the documented procedure at all times.
 - (3) Uniquely identifiable (e.g., unique title for electronic procedures, distinctive border, or cut corners).

Note: Reference [KNPR 8715.2, Comprehensive Emergency Management Plan \(CEMP\)](#), for facility EPD requirements.

6.2.11.3 Changes/Modifications to All Documented Procedures

- a. All technical changes/modifications shall be released as a revision by following the normal approval process or will be documented and approved as a deviation.

Note: Deviations are not required for non-technical or editorial changes.

- b. All deviation requests and revisions shall be approved prior to implementation.

Note: For emergency or time-critical situations, operations may continue with the deviation processed after the fact, provided concurrences are recorded on the net or documented within the documented procedure.

- c. Changes/modifications to procedural steps (or to the order of the procedural steps) which address safety controls shall obtain concurrence from the appropriate safety organization.

Note: During the assessment phase of the operational review defined in [Section 6.1](#), NASA and the operating organization will document the appropriate safety organization.

- d. All approved deviations or other documentation authorizing permanent changes to a documented procedure during its use shall be incorporated or addressed as part of the next change or revision.

- e. All documented procedures/revisions/deviations involving the flight termination system shall be forwarded to the KSC Range Safety Manager for coordination with the appropriate signatories per [NPR 8715.5, Range Flight Safety Program](#).

6.2.11.4 Content Requirements for Hazardous Documented Procedures

- a. All conditions that cause the documented procedure to be classified as hazardous shall be identified.

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- b. Documented procedures shall include a list identifying all essential personnel, their call sign/functional title, and the organization or contractor employing each individual.
- c. Prior to performing the step(s) of the hazardous procedure that direct the hazardous task/sequence, verification of the following items shall be documented in the hazardous procedure:
- (1) A pre-task briefing has been performed.
 - (2) All personnel participating in the hazardous task/sequence are certified for hazardous tasks requiring certification (e.g., certification requirements in [NPR 8715.3, NASA General Safety Program Requirements](#)).
 - (3) All personnel participating in the hazardous task/sequence have reviewed the documented procedure.
 - (4) Control areas are properly installed and enforced.
 - (5) Safety has concurred with proceeding.
- d. Prior to use, final version of any new, changed, or revised hazardous documented procedure shall be reviewed and approved by the appropriate SMA professional(s) to ensure compliance with the requirements herein.

6.2.12 WIND

The program/project or directorate organization shall establish outdoor work restrictions for steady-state winds of 18 knots (20.7 mph) or greater, or gusts of wind of 22 knots (25 mph) or greater.

Note: Weather advisories, including wind advisories, watches, and warnings are defined in the Air Force 45th Weather Squadron (45WS) Space Wing Instruction (SWI) 15-101, Weather Support, and have been tailored for KSC use. A Wind Advisory is given for observed > 18 knot steady-state winds occurring at KSC from the surface to 300 feet, and is intended to notify personnel in specific high-density operational areas when a wind hazard is approaching or is present. Weather announcements are made on the KSC Paging and Area Warning System (PAWS) and select KSC radio system voice nets.

6.3 HAZARD-SPECIFIC MANDATED CONTROLS

All of the hazard-specific mandated controls which are part of the operation shall be included in the assessment required by [section 6.1](#) of this document.

6.3.1 MATERIALS PROCESSING

- a. When using flammable materials/commodities or hypergolic commodities, materials shall be selected, tested, assessed, and approved per [NASA-STD-6001, Flammability, Offgassing, and Compatibility Requirements and Test Procedures](#).

b. Materials shall also be selected, tested, assessed, and approved per [KSC-MMA-1985-79, Standard Test Method for Evaluating Triboelectric Charge and Decay for Electrostatic Discharge](#).

Note 1: For GSE materials, also reference [NASA-STD-5005, Standard for the Design and Fabrication of Ground Support Equipment](#).

Note 2: Currently approved plastic film, foam, and adhesive tape listings can be found in [Kennedy Technical Instruction \(KTI\)-5212, Material Selection List for Plastic Films, Foams, and Adhesive Tapes](#).

6.3.2 CRYOGENICS

a. Any compartment subject to gaseous hydrogen accumulation during servicing or loading shall meet the requirements of NFPA 69, Standard on Explosion Prevention Systems.

b. Cryogenic fluid systems shall be depressurized, made safe, and evaluated for safe handling with respect to low temperatures before attempting any type of maintenance.

c. The oxygen content in LH₂ transfer lines shall be less than 1 percent (inert) prior to start of LH₂ flow.

6.3.3 HYPERGOLIC PROPELLANTS

6.3.3.1 Static Hypergolic Propellant Requirements

a. Toxic vapor detection shall be performed to verify a safe environment prior to entering a controlled area where hypergolic propellants are in use, stored, or where systems are being serviced.

b. Hypergolic propellant storage areas and areas with make or break connections in hypergolic propellant systems shall be provided with spill protection and containment.

c. The capacity of the containment for hypergolic propellant storage areas and areas with make or break connections in hypergolic propellant systems shall be based on the worst-case credible spill plus the anticipated volume of water from the fire protection system.

d. Safety showers/eyewash shall be provided for all areas where hypergolic propellants are used or stored.

e. Areas where hypergolic propellants are stored or used shall be equipped with wind socks.

6.3.3.2 Dynamic Hypergolic Propellant Requirements

a. Prior to commencing operations, bonding and grounding shall be provided between the ground point and the hypergolic propellant system (to include portable equipment) being loaded.

b. Flow or servicing of hypergolic propellants shall only be allowed in facilities sited per [NASA STD 8719.12, Safety Standard for Explosives, Propellants, and Pyrotechnics](#).

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- c. Transfer of hypergolic propellants from mobile tankers to ground storage units and transfer from ground storage units to spacecraft shall have a safing plan approved by NASA SMA.
- d. Charged water lines shall be provided during all operations where potential exists for hypergolic propellants to leak or be spilled.
- e. Operating organizations shall obtain wind profile data for worst-case credible spill quantities greater than half a gallon, prior to and during any hypergolic propellant handling or transfer operation, to be used in the approval of starting and continuing of the operations..
- f. The control areas shall:
 - (1) Be based on the worst-case credible spill.
 - (2) Consider a downwind corridor.
Note: Where ½ gallon or less worst-case credible spill is anticipated, a standard 200/700ft clear and downwind corridor can be used without detailed analysis. In this case, if winds are less than 3 knots, the clear will be expanded to 700ft.

6.3.4 HEAT PRODUCING DEVICES

The requirements in this section within are the purview of the KSC AHJ. Any requests for interpretation or relief will go through the AHJ. The requirements in this section are KSC-specific requirements in addition to the Agency-level requirements for flame producing devices and welding in Section 11.8 of [NASA-STD-8719.11, Safety Standard for Fire Protection](#).

- a. Heat producing devices used within 10 feet of flammable, combustible, or explosive materials shall require the applicable organization to obtain a [KSC Form 2-271, Hot Work, New Construction, Demolition Permit](#).
- b. The use of spark producing devices is prohibited in the locations identified for smoking in Section 11.3 of [NASA-STD-8719.11, Safety Standard for Fire Protection](#).

6.3.5 ELECTRICAL SYSTEM OPERATIONS AND MAINTENANCE (LIGHTNING HAZARD)

- a. During applicable Phase II Lightning Warnings or when a lightning hazard exists, personnel shall not commence electrical maintenance in exposed areas, on the outside of any facility, or inside any facility that is not lightning-protected.
- b. Electrical maintenance in exposed areas, on the outside of any facility, or inside any facility that is not lightning-protected that is already in progress when a Phase II Lightning Warning is announced or a lightning hazard exists shall be halted safely for the duration of the Phase II Lightning Warning period or the cessation of the lightning hazard.
- c. During applicable Phase II Lightning Warnings or when a lightning hazard exists, personnel shall not commence electrical work inside of any facility on systems that are connected to utility services capable of conducting currents which enter the structure from the outside .

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Note: Work, other than electrical work, on systems connected to utility services capable of conducting currents which enter the structure from the outside may still pose a risk to personnel. An assessment of the risk should be performed prior to the commencement of non-electrical work on these systems during a Phase II (See Section 3.2.2.1.c.)

d. Electrical work inside of any facility on systems that are connected to conductors which enter the facility from the outside that is already in progress when an applicable Phase II Lightning Warning is announced or a lightning hazard exists shall be safely halted for the duration of the Phase II Lightning Warning period or the cessation of the lightning hazard.

e. Personnel performing facility and system electrical work inside of lightning-protected facilities during a Phase II Lightning Warning or when a lightning hazard exists shall ensure the system being worked on is:

- (1) Disconnected from electrical circuits entering the facility from the outside.
- (2) Physically disconnected by a minimum of six inches from the outside conductive objects (e.g., metal pipes, wires, transformers, antenna cables, power cables, conduits).
- (3) Inside a facility that has underground, surge-protected electrical services, and all aboveground electrically connected conductive sources are within the lightning protection system zone, and there is a one inch gap disconnect from outside conductive sources.

Note: The one inch gap disconnect may be satisfied by opening a circuit breaker.

f. With concurrence from the onsite safety representative, the task leader shall be permitted to authorize otherwise-unauthorized emergency maintenance work required to remedy an unsafe condition.

g. During applicable Phase II Lightning Warnings or when a lightning hazard exists, personnel shall not commence maintenance on any system that is connected to an external antenna mounted outside a facility.

h. Maintenance on any system with an external antenna mounted outside a facility that is already in progress when an applicable Phase II Lightning Warning is announced or a lightning hazard exists shall be safely halted for the duration of the Phase II Lightning Warning period or the cessation of the lightning hazard.

6.3.6 KSC GROUND-BASED VESSELS AND PRESSURIZED SYSTEMS

Specific hazard controls for operations involving Pressure Vessels and Pressurized Systems (PVS) can be found within the overall PVS requirements in [Chapter 7](#).

6.3.7 FLIGHT HARDWARE PRESSURE VESSEL SAFETY REQUIREMENTS

Specific hazard controls for operations involving Flight PVS can be found within the overall Flight PVS requirements in [Chapter 8](#).

6.3.8 EXPLOSIVES, PROPELLANTS, AND PYROTECHNICS

Specific hazard controls for operations involving Explosives can be found in [Chapter 9](#).

6.3.9 LIFTING DEVICES AND EQUIPMENT

Specific hazard controls for operations involving Lifting Devices and Equipment can be found in [Chapter 10](#).

CHAPTER 7: KSC GROUND-BASED VESSELS AND PRESSURIZED SYSTEMS

a. KSC personnel performing activities that involve ground-based PVS designed for or operating at positive or negative gauge pressure (including-NASA owned/operated, temporary or permanent, and non-NASA-owned contractor/tenant PVS operated on NASA property determined by the Pressure Systems Manager (PSM) to pose a risk to KSC personnel, facilities, or equipment) which are not specifically excluded per [NASA-STD-8719.17, NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems \(PVS\)](#), shall comply with NPD 8710.5 Policy for Pressurized Vessels and Pressurized Systems and the additional KSC-specific PVS requirements in this chapter.

b. As used in this chapter, the terms “certify” and “certification” imply the terms “recertify” and “recertification” where the context dictates.

The Kennedy Space Center Pressure System Management Plan, [KSC-PLN.8719 PVS](#), provides the Center's approach to managing the PVS Program to ensure compliance with the NASA-STD-8719.17.

7.1 PRESSURE VESSELS AND PRESSURIZED SYSTEMS PROGRAM REQUIREMENTS

a. PVS shall be certified in accordance with the requirements of [NASA-STD-8719.17, NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems \(PVS\)](#), and this KNPR before being placed into service.

b. The PVS owner shall correct all safety-related hardware discrepancies before the certification will be approved unless permission is obtained from the PSM. The PSM will require a work order to be opened and an estimated completion date within a suitable timeframe be documented in the certification report. Safety related discrepancies not addressed in the identified timeframe will invalidate the system's certification.

c. Non-safety related hardware discrepancies shall be dispositioned and corrected. Regularly scheduled maintenance plans may be utilized.

d. PVS that will only be brought online occasionally, as-needed, or during specific operations (i.e., “standby” or “contingency”) shall be treated as if they are in continuous service.

e. The certification of PVS that will only be brought online occasionally, as-needed, or during specific operations (i.e., “standby” or “contingency”) shall be maintained to conform to expected service conditions.

f. Non-DOT vessels may only be transported within the contiguous boundary of KSC with a blanket purge not to exceed 25 pounds per square inch (psi) or 1/5 maximum operating pressure (MOP) (whichever is less) for relocation..

Note: Vessels being transported within the boundaries of Cape Canaveral Air Force Station are subject to the requirements of the 45th Space Wing Safety Office which may be more stringent than KSC requirements.

g. Pressure systems shall always be depressurized before disconnection, repairs, or replacements are attempted.

7.2 DOCUMENTATION REQUIREMENTS

PVS Documentation shall be obtained and maintained as described in NASA-STD-8719.17, NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems (PVS)

7.3 TESTING REQUIREMENTS

- a. Testing of pressure systems shall be conducted in accordance with applicable NCS and equipment technical manuals.
- b. All test reports shall be traceable to its respective PVS certification report.

7.4 IN-SERVICE INSPECTION REQUIREMENTS

In-Service Inspection (ISI) Plans are required for PVS per [NASA-STD-8719.17, NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems \(PVS\)](#), section 4.8.3. Failure to perform ISI required maintenance and inspections will invalidate the system's certification. .

7.5 MARKING AND IDENTIFICATION REQUIREMENTS

Marking and labeling requirements shall conform to the applicable design specifications, NCSs, and fabrication and installation drawings.

7.5.1 MANUFACTURER'S NAMEPLATE

- a. Manufacturer nameplates vary with regards to type, size, location, and contents but generally contain the following: MAWP or design pressure, temperature range, capacity, material, media, model number or serial number and other information.
- b. Nameplates shall be accessible and legible.

7.5.2 MAXIMUM ALLOWABLE WORKING PRESSURE AND NAME OF SERVICE FLUID

- a. MAWP and Name of Service Fluid shall be displayed on the vessel in a conspicuous location and be legible at a distance of 50 feet (16 meters).
- b. Where multiple vessels are grouped together to store the same fluid at the same pressure, it shall be permissible for only the most conspicuous vessel in the group to be labeled.

7.5.3 MAXIMUM OPERATING PRESSURE

MOP designation use is optional but is generally reserved for applications where the maximum operating pressure used with a given pressure vessel is lower than the vessel's capability or MAWP.

- a. When used, the MOP shall be displayed on the vessel in a conspicuous location.

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- b. Where multiple vessels are grouped together to store the same fluid at the same pressure, it shall be permissible for only the most conspicuous vessel in the group to be labeled.
- c. The marking, which may be somewhat larger than that for the MAWP, shall be legible at a distance of 50 feet (16 meters).

7.5.4 OTHER VESSEL MARKINGS

- a. Find Number (Axxxxxx), the KSC-unique, alphanumeric identifier, shall be designated by stencil or corrosion-resistant, metal tag and may be grouped together on conspicuous signage in cases where vessels are banked together.
- b. KSC PVS Certification Program Nameplate - Each certified pressure vessel shall have a corrosion-resistant plate, tag, or stenciled sign permanently affixed as near as possible to the original manufacturer's name-plate bearing at least the following information:

"KSC PVS CERTIFICATION PROGRAM, CERTIFIED
MAWP xxxx psig," "CERTIFICATION DATE (Month and Year)."
"EXPIRES (Month and Year)," and "REPORT NUMBER"

7.5.5 RELIEF VALVES

- a. Each relief valve shall be labeled or tagged to include the following:
 - (1) Set pressure in psig
 - (2) Date (month and year) valve was set or tested
 - (3) Next due date (month and year)
 - (4) Manufacturer's nameplate
- b. The pressure shown shall be the nominal pressure, exclusive of any tolerance, specified by appropriate engineering directive.
- c. Each relief valve shall have a Find Number on the panel front (plate) next to the relief valve schematic symbol or the panel back (ink-stamp or tag).

7.5.6 PRESSURE GAUGES

Each pressure gauge that is periodically recalibrated shall have a calibration sticker affixed to the gauge dial or cover/lens to include the following:

- a. Calibration date (month and year)
- b. Next due date (month and year)

7.5.7 TRANSDUCERS

a. Each transducer that is periodically recalibrated shall have a calibration sticker affixed to the body of the instrument or to an identification tag which will include the following:

- (1) Calibration date (month and year)
- (2) Next due date (month and year)
- (3) Unique Identification Number

b. Each transducer shall have a Find Number on panel front (plate) next to the transducer schematic symbol or the panel back (ink-stamp or tag).

7.5.8 PANEL TUBING

Each tube assembly shall have an identification tag which will include the following:

- a. Tube diameter and wall thickness
- b. Test pressure
- c. Test date (month and year)
- d. Other miscellaneous information required by controlling system design specification

7.5.9 MISCELLANEOUS COMPONENTS

Miscellaneous components (e.g., hand valves, check valves, regulators, filters) shall be marked or identified with at least a Find Number on the panel front (plate) and back (ink-stamping or tag).

7.5.10 PANEL FACE MARKING

- a. Each panel front (face) shall be marked with a one-line schematic representing commodity flow, panel inlets and outlets, schematic symbols, and respective component Find Numbers.
- b. Each panel front shall have signage indicating descriptive information such as panel title, drawing number, and program model number, as required by respective design specification.
- c. Each panel shall be labeled to include the maximum inlet pressure and commodity(ies).

7.5.11 INTERCONNECTING PIPING, TUBING, AND IN-LINE COMPONENTS

- a. Interconnecting piping and tubing shall be marked to indicate commodity, direction of flow, and nominal operating pressure in accordance with respective design specifications.
- b. In-line components shall be marked or identified with at least a Find Number.

Note: If these components are pressure gauges or transducers, the marking requirements of [section 7.6.2](#) apply.

7.5.12 FLEXHOSES

a. All flexhose assemblies in use shall have corrosion-resistant metal tag(s) attached indicating at least the following information:

- (1) Fabrication Date (month and year) if flex hose has a limited life concern.
- (2) Hydrostatic test date (month and year)
- (3) Current, periodic visual inspection and next due date (month and year)
- (4) Manufacturer's name and part number or KSC part number
- (5) Rated working pressure
- (6) Serial number, if applicable
- (7) Service media (only for dedicated fluid hoses in support of any oxygen, hydrocarbon, or hypergolic propellants system)
- (8) For Type I hoses, a find number

b. Excluding flexhoses contained in commercial off-the-shelf equipment approved by UL, National Institute for Occupational Safety and Health, or other safety certifying organizations, all new or refurbished flexhose assemblies in inventory under the control of a logistics organization shall have corrosion-resistant metal tag(s) attached that bears at least the following information:

- (1) Fabrication Date (month and year) if flex hose has a limited life concern.
- (2) Hydrostatic test date (month and year)
- (3) Manufacturer's name and part number or KSC part number
- (4) Rated working pressure
- (5) Serial number, if applicable

7.5.13 PORTABLE AND MOBILE PRESSURE SYSTEMS

KSC-owned portable and mobile PVS shall be marked in accordance with KSC Drawing 81K04331, "Specification for Marking of Propellant Portable Containers," or in accordance with KSC Drawing 81K00643, "Specification for Marking of Mobile GSE."

Note: Other portable and mobile pressure systems shall be marked in accordance with [Title 49 CFR, Hazardous Materials Regulations](#), requirements for hazardous materials.

7.6 DESIGN, REPAIRS, ALTERATIONS, OR MODIFICATIONS

- a. PVS manufacturing or alteration shall be in strict accordance with the quality assurance manual of the manufacturing organization, applicable NCS, and KSC design standards (KSC-STD-Z-000X), if applicable.
- b. Alterations or repairs to vessels shall be performed by an NBIC Certified R-Stamp Certificate holder and inspected in accordance with the requirements of the applicable NCS.

7.7 FLEXIBLE HOSES

- a. Flex hose handling and installations shall be in accordance with 80K51846.
- b. Metallic and nonmetallic flexhoses shall be assembled, connected, and disconnected in accordance with the manufacturer's specifications and recommendations and tested in accordance with the applicable NCS.
- c. Rated working pressure for all flexhose assemblies shall not exceed 25 percent of the manufacturer's specified minimum burst pressure.
- d. Adequacy of the structure to which hose end restraints are attached shall be determined by a system/test engineer.

(1) A hose containment grip shall be installed across each intermediate union or splice on hoses over 4 feet (1.2 meters) in length.

(2) For hoses over 2 feet (0.6 meters) in length, pressurized above 150 psig [1.03 megapascal (MPa)]:

- (a) The hose shall be restrained at each end by an approved corrosion resistant device and restrained every 6 feet of length by securely attaching to the structure in a manner that in no way interferes with the hose flexibility.

Note: Pre-approved restraints can be found in [KSC-UG-8715.3, KSC Safety User's Guide](#).

- (b) If the hose cannot be securely attached to the structure every 6 feet, 50lb sandbags, or ingots (or other suitable weights as approved by the appropriate engineering organization) shall be used at a minimum of 6-foot intervals to prevent the hose from whipping around in the event of a burst.

Note 1: Restraint requirements are not required for hoses contained by surrounding structure that can provide protection to personnel and hardware.

Note 2: Restraint requirements are not required for hoses outward from the end of swing arms or tail service masts to flight vehicle interfaces.

- e. All nonmetallic hoses greater than or equal to 1 inch used for hydrazine (N₂H₄), monomethylhydrazine (MMH), or nitrogen tetroxide (N₂O₄) service shall be internally inspected (visually) for any indication of the hose liner blistering after each full year of cumulative exposure to any of these fluids.

f. All nonmetallic hoses less than 1 inch used for N₂H₄, MMH, or N₂O₄ service shall be pressure tested to MOP after each full year of cumulative exposure to any of these fluids.

Note: Since hoses that are less than 1 inch have physical limitations to internal inspection, a pressure test will be used instead of internal inspections.

7.7.1 HYDROSTATIC/PNEUMATIC TEST

a. Each hose assembly shall be hydrostatically tested to a minimum 150 percent or pneumatically tested to 110 percent of the hose's design rated working pressure at the time of manufacture/ fabrication unless specified by the Operational Maintenance Requirements and Specifications Document design-controlled drawing or manufacture's specification.

b. Flexhoses shall be retested hydrostatically, or pneumatically, after modification or repair to verify the integrity of the modification or repair. Test per 80K51846, applicable NCS, or manufacturers' recommendations.

7.7.2 PERMANENTLY INSTALLED HOSES

a. If system has not been operational within the past 12 consecutive months, prior to use permanently installed hoses used with toxic/lethal fluids, regardless of operating pressure, shall have the end fittings and intermediate splices leak tested at the maximum system operating pressure using an inert gas.

b. Permanently installed flexhoses that operate at 150 psig [1.03 MPa (gauge)] or higher pressure or are used with toxic/lethal fluids, shall be externally, visually inspected over their entire length at least annually for damaged fittings, broken braid, kinks, flattened areas, or other evidence of degradation.

7.7.3 TEMPORARY-USE HOSES

Temporary-use flexhose assemblies are used for transfer of cryogenics, gases, hypergolic propellants, hazardous waste, and toxic/corrosive fluids in applications where the hoses are routinely connected/disconnected, such as in fluid transfer operations or in test setups.

a. Temporary use hoses used with toxic/lethal fluids, regardless of operating pressure, shall have the end fittings and intermediate splices leak tested (at least) annually at the design rated operating pressure of the hose using an inert gas.

b. Prior to use, all other temporary-use flexhoses that operate at 150 psig [1.03 MPa (gauge)] or higher pressure, or are used with toxic/lethal fluids, shall be externally, visually inspected over their entire length for anomalies such as kinks, flattened sections, and deformities.

7.8 INACTIVE, UNSAFE, AND DECOMMISSIONED PRESSURE VESSELS AND PRESSURIZED SYSTEMS

7.8.1 INACTIVE PRESSURE VESSELS AND PRESSURIZED SYSTEMS

- a. For each inactive vessel/system, the organization responsible for the ground-based PVS shall update the appropriate database to reflect the change of status.
- b. Inactive PVS shall be stenciled or otherwise conspicuously labeled:

“INACTIVE-VERIFY CERTIFICATION BEFORE REUSE”

- c. All maintenance shall be performed, all appropriate inspections completed, and active certification verified prior to inactive PVS being returned to service.

7.8.2 STORAGE REQUIREMENTS FOR INACTIVE PRESSURE VESSELS AND PRESSURIZED SYSTEMS

- a. Inactive PVS shall be drained and inerted.
- b. Inactive PVS shall be protected against exposure to adverse environments which could cause corrosion or other forms of material degradation.
Note: Internal pressure up to 10 psig with a dry, inert gas should be considered to prevent contamination and internal corrosion.
- c. Inactive PVS shall be protected against mechanical damages resulting from scratches, dents, and mechanical impacts.
- d. Induced stresses due to storage fixture constraints shall be minimized by suitable storage fixture design.
- e. An engineering review of minimum maintenance required for the system components shall be conducted to include periodic inspections to ensure all storage conditions have been met.

7.8.3 UNSAFE OR DECOMMISSIONED PRESSURE VESSELS AND PRESSURIZED SYSTEMS

- a. When a vessel/system is determined to be unsafe for continued use, it shall be immediately removed from service.
- b. If the unsafe PVS is repairable and if future use is intended, it shall be repaired per the appropriate NCS.
- c. If the unsafe PVS cannot be repaired, it shall be decommissioned and disposed of in accordance with [KNPR 4000.1, Supply and Equipment System Manual](#).
- d. Each unsafe PVS shall be physically disabled and stenciled with the following:

“NOT USABLE - FOR DISPOSAL ONLY.”

e. If the PVS cannot be repaired and cannot be physically moved, it shall be abandoned in place and stenciled with the following:

“NOT USABLE – ABANDONED IN PLACE”

f. For each disposed or abandoned vessel/system, the appropriate database shall be updated to reflect the change of status.

Note: Disposal method of pressure vessels should follow appropriate procedures (excessed in accordance with KNPR 4000.1, Supply and Equipment System Manual, appropriately marked, and method of physically disabling the pressure vessel).

7.9 PRESSURE VESSELS AND PRESSURIZED SYSTEMS DATABASE

a. The KSC PSM shall maintain the certification status of all ground-based PVS at KSC.

b. Each organization responsible for one or more PVS shall maintain a comprehensive inventory of their PVS. The PSM office maintains a PVS database in which organizations can utilize to meet this requirement or organizations can maintain their own database.

c. Responsible organizations shall update the inventory quarterly and forward it to the KSC PSM with changes highlighted.

d. The responsible organization’s inventory shall include at least the following items:

- (1) Certification report number
- (2) System description
- (3) Total number of subsystems covered by the certification report
- (4) Total number of serial numbers covered by the certification report
- (5) Total number of pressure vessels covered by the certification report
- (6) Total number of pressure vessels ASME code stamped
- (7) Total number of pressure vessels not ASME code stamped
- (8) Commodity or commodities
- (9) MAWP
- (10) Physical location of system
- (11) Recertification due date
- (12) Pertinent recertification requirements document [e.g., this document, [NASA-STD-8719.17, NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems \(PVS\)](#)]

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(13) Comments as necessary

e. The responsible organization shall maintain the total number of compressed gas trailers and mobile tankers tested, qualified, and inspected per 49 CFR or DOT Special Permit.

CHAPTER 8: FLIGHT HARDWARE PRESSURE VESSEL SAFETY REQUIREMENTS

In addition to the requirements contained in [NPD 8710.5, Policy for Pressure Vessels and Pressurized Systems](#), the requirements in this chapter are applicable at KSC for Civil Servants and NASA contractors working with NASA or non-NASA owned or operated flight hardware operated on NASA KSC property.

8.1 SAFETY REQUIREMENTS FOR DESIGN, TEST, AND GROUND PROCESSING OF FLIGHT COMPOSITE OVERWRAPPED PRESSURE VESSELS

- a. The design, qualification, and acceptance testing of COPVs shall comply with the requirements of ANSI/American Institute of Aeronautics and Astronautics (AIAA) S-081, "Space Systems-Composite Overwrapped Pressure Vessels (COPVs)."
- b. The PVS owner shall ensure that a Mechanical Damage Control Plan (MDCP) for COPVs is developed and obtain approval of the MDCP from the applicable NASA safety organization and engineering organization.
- c. Prior to the first pressurization of COPVs, an inspection of the vessel for visible damage shall be performed by a "trained inspector," defined as an inspector possessing skills equivalent to a Level II visual inspector per the American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A (see ANSI/AIAA S-081)

Note: This inspection should take place at the launch site. If a COPV will not be accessible at the launch site, this inspection may be conducted the last time the vessel is accessible.

- d. COPV pressurizations at KSC shall be conducted remotely or with approval of the PSM (or ESO for explosive commodities), employ a blast shield designed to prevent personnel exposure to fragmentation when the pressurization is greater than one third of the design burst pressure.
- e. When the pressurization is greater than one third of the design burst pressure, personnel shall remain clear of the COPV clear area for at least 10 minutes after pressurization is complete if the COPV is to remain pressurized after testing.

Note: For pressure systems, the clear area is determined using the Safe Distance Calculations found in [ASME PCC-2](#).

- f. Personnel limits for each operation near the COPV/Spacecraft shall be established to minimize personnel exposure to the pressurized tank when at pressures greater than one third of the design burst pressure.
- g. The personnel limit areas and the safety clears during pressurization shall be based on pressure vessel blast/fragmentation analysis or appropriate Quantity-Distance (QD) siting analysis.

Note: For pressure systems the Clear area is determined using the Safe Distance Calculations found in ASME PCC-2, when explosives are involved the QD is calculated in accordance with [NASA-STD-8719.12](#).

h. COPVs pressurized to greater than one third of the design burst pressure shall be transported along approved routes that minimize exposure to personnel and facilities, be accompanied by an authorized escort vehicle, and take place during "off-shift" time periods.

i. The operating organization shall develop Emergency Response Plans (ERPs) that include contingency safing and backout plans for COPVs containing hazardous fluids or in proximity to hazardous commodities.

- (1) The ERPs shall consider leaks, impacts, and exposure to incompatible chemical agents.
- (2) If implemented, a real-time assessment shall be accomplished and contingency operations taken as required.
- (3) The ERP shall be approved prior to the start of ground operations by the applicable NASA Safety organization.

8.2 FLIGHT METALLIC PRESSURE VESSEL REQUIREMENTS

In accordance with section 1.a(3) of [NPD 8710.5, Policy for Pressure Vessels and Pressurized Systems](#), it is NASA policy to qualify and accept spaceflight PVS in accordance with ANSI/AIAA S-080, Space System Metallic Pressure Vessels, Pressurized Structures, and Pressure Components.

a. If flight metallic pressure vessel owners cannot demonstrate compliance with ANSI/AIAA S-080, the vessel owner shall obtain evaluation, certification, and risk acceptance from the appropriate KSC safety review panel (prior to operating) in accordance with program management risk acceptance requirements.

Note 1: In accordance with section 1.a(9) of [NPD 8710.5, Policy for Pressure Vessels and Pressurized Systems](#), the certification status of PVS will be documented and maintained to indicate all exceptions, waivers, nonconformances, special constraints, or instructions required for safe operation of the PVS.

Note 2: If a fracture control plan is available, the provider of a flight metallic pressure vessel should submit the fracture control plan to, and obtain approval to proceed from, the appropriate Fracture Control Panel prior to processing the flight metallic pressure vessel at KSC.

b. A trained, qualified inspector shall perform an inspection of flight metallic pressure vessels for visible damage prior to the first pressurization.

Note: This inspection should take place at the launch site. If a flight metallic pressure vessel will not be accessible at the launch site, this inspection may be conducted the last time the vessel is accessible.

c. If the flight metallic pressure vessel is to be pressurized to pressures equal to or greater than one half of the flight metallic pressure vessel's design burst pressure:

- (1) The pressurizations shall be performed remotely or employ an appropriately designed blast shield to protect personnel.

- (2) Personnel shall not be permitted access to the area for at least ten minutes after pressurization is completed if the vessel is to remain pressurized.

- d. Personnel limits for each operation near the flight metallic pressure vessel shall be established to minimize personnel exposure to the pressurized tank when at pressures greater than one half of the design burst pressure.

- e. The operating organization shall develop ERPs for flight metallic pressure vessels containing hazardous fluids or which are in close proximity to hazardous commodities.
 - (1) ERPs shall include safing and backout plans.
 - (2) ERPs shall address leaks, impacts, and exposure to incompatible chemical agents.
 - (3) The operating organization shall obtain approval from the appropriate NASA Safety organization for ERPs prior to starting the ground operations addressed in the ERP.
 - (4) If an ERP is implemented, a real-time assessment shall be accomplished and contingency operations taken as required.

- f. The flight PVS-owning organization shall maintain records for each Pressure Vessel System including Fracture mechanics controlled pressure vessel/systems processed at KSC, identifying how many times the vessel/system has been pressurized, the pressure levels, liquids/gases used, duration of the pressure cycles, any other pertinent data, and the total number of cycles for which the vessel/system was designed.

8.3 PROTOTYPE / PROTOFLIGHT PRESSURE VESSEL REQUIREMENTS

- a. If a prototype/protoflight pressure vessel is not DOT-certified or it is being pressurized to a pressure above the DOT-certified operating pressure, the pressure vessels should meet the requirements in their respective section above ([section 8.2](#) for COPVs and [section 8.3](#) for metallic pressure vessels).

- b. If the prototype or protoflight metallic pressure vessels do not meet their respective section requirements, the vessel owner shall obtain evaluation, certification, and risk acceptance from the appropriate KSC safety review panel (prior to operating) in accordance with program management risk acceptance requirements.

CHAPTER 9: EXPLOSIVES, PROPELLANTS, AND PYROTECHNICS

As required in NPR 8715.3 and applicable contracts, Civil Servants and NASA contractors will meet the requirements of [NASA-STD-8719.12, Safety Standard for Explosives, Propellants, and Pyrotechnics](#) and [NASA-STD-8719.24 NASA Expendable Launch Vehicle Payload Safety Requirements](#). The requirements in this chapter are applicable at KSC in addition to the requirements contained in [NASA-STD-8719.12, Safety Standard for Explosives, Propellants, and Pyrotechnics](#) and [NASA-STD-8719.24 NASA Expendable Launch Vehicle Payload Safety Requirements](#).

9.1 EXPLOSIVES TEST EQUIPMENT

a. Only Explosives Test Equipment (ETE) designed in accordance with NASA-STD-8719.12 shall be used.

Note: The 30th or 45th Space Wing (SW) maintain a list of ETE approved for use in a joint Air Force/NASA jurisdiction facility.

b. Responsible organizations shall submit requests for concurrence to the ESO prior to use when there are changes made to ETE.

c. Requests for changes shall provide the following data:

- (1) Model number
- (2) Mechanical/electrical engineering drawings and specifications
- (3) System safety analysis

d. A valid calibration seal shall be maintained on all approved ETE.

9.2 SAFE AND ARM DEVICES

Two firing inhibits shall remain when removing a safe and arm (S&A) safing pin.

9.3 OPERATIONAL REQUIREMENTS WHILE A LIGHTNING HAZARD EXISTS

9.3.1 ALL EXPLOSIVE/ORDNANCE OPERATIONS DURING THE PRESENCE OF A LIGHTNING HAZARD IN EXPOSED AREAS AND WITHIN NONLIGHTNING PROTECTED FACILITIES

a. Lightning-protected facilities where explosive, ordnance, and solid propellant operations take place shall be considered nonlightning-protected facilities if doors and other openings remain open.

b. When in exposed areas or within nonlightning-protected facilities, personnel shall not commence explosive/ordnance operations during a Phase II Lightning Warning or when a lightning hazard exists.

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c. When in exposed areas or within nonlightning-protected facilities, explosive/ordnance operations already in progress when a Phase II Lightning Warning is announced or when a lightning hazard exists shall be safely halted for the duration of the Phase II Lightning Warning or the duration of the lightning hazard.

Note: Explosive/ordnance operations in facilities that are lightning-protected and completely closed up may commence or continue when those operations do not violate the lightning requirements of this document. Lightning requirements are located in Sections 6.3.5 for Electrical System Operations and Maintenance, and 10.5 for explosive operations involving cranes.

d. During a Phase II Lightning Warning or when a lightning hazard exists, personnel shall utilize fully-enclosed metal vehicles when transporting ordnance.

e. Personnel shall not load or unload ordnance outdoors during a Phase II Lightning Warning or when a lightning hazard exists.

9.3.2 ELECTROEXPLOSIVE DEVICE AND NASA STANDARD INITIATOR OPERATIONS

a. During a Phase II Lightning Warning or when a lightning hazard exists, personnel shall not commence operations involving electrical connections and disconnects, other operations involving wires already connected to EEDs, or tests of EEDs and NASA Standard Initiator (NSI) operations with Faraday caps removed or wires attached.

b. Operations involving electrical connections and disconnects, other operations involving wires already connected to EEDs, or tests of EEDs and NSIs with Faraday caps removed or wires attached already in progress shall be safed and safely halted for the duration of the Phase II Lightning Warning or until the lightning hazard no longer exists.

9.3.3 ROTATION OF SAFE AND ARM DEVICES

a. Personnel shall not perform rotation of S&A devices with NSIs installed during a Phase II Lightning Warning or when a lightning hazard exists.

b. If rotation of S&A devices with NSIs installed is in progress when a Phase II Lightning Warning is called or when a lightning hazard exists, the Safe and Arm devices shall be returned to the safe position.

c. When performing offline S&A rotations during a Phase II Lightning Warning or when a lightning hazard exists, S&A devices shall be installed in a test chamber.

9.3.4 SOLID PROPELLANT GRAIN INSPECTIONS

a. During Phase II Lightning Warnings or when a lightning hazard exists, personnel shall not commence solid propellant grain inspection.

b. Solid propellant grain inspections already in progress when a Phase II Lightning Warning is announced or when a lightning hazard exists shall be safely halted for the duration of the Phase II Lightning Warning period or until the lightning hazard no longer exists.

CHAPTER 10: LIFTING DEVICES AND EQUIPMENT

As required in NPR 8715.3 and applicable contracts, Civil Servants and NASA contractors will meet the requirements of [NASA-STD-8719.9, Lifting Standard](#). The requirements in this chapter are applicable at KSC in addition to the requirements contained in [NASA-STD-8719.9, Lifting Standard](#).

10.1 LOAD TESTING

- a. Lifting equipment load tests shall not be performed above flight hardware or critical GSE or when failure of the lifting equipment could damage flight hardware or critical GSE.
- b. Only those cranes approved for load testing by the Lifting Devices and Equipment Manager (LDEM) shall be used to load test other lifting devices.

Note: The KSC list of cranes permitted to be used for load testing of other lifting devices is posted at the following website: <https://sma.ksc.nasa.gov/LDE>.

- c. Responsible organizations shall submit requests for changes to the KSC List of Cranes Used for Load Testing to the KSC LDEM.
- d. Requests for changes to the list shall state what load testing will be performed and include the following:

- (1) Design standard(s)
- (2) Design safety factor(s)
- (3) Test history
- (4) Operations history
- (5) Maintenance history
- (6) Other acceptance rationale to perform the load testing

10.2 NON-LOAD TESTING SLINGS

- a. Only slings approved by the LDEM shall be exempt from required load test requirements.

Note: The KSC List of Non-Load Test Slings (i.e., slings not requiring periodic load tests) is posted at the following website: <https://sma.ksc.nasa.gov/LDE>.

- b. Responsible organizations shall submit requests for changes to the KSC List of Non-Load Test Slings to the KSC LDEM. The LDEM will approve/disapprove changes to the list.
- c. Requests for additions to the list of non-load test slings shall specify the following:
 - (1) Description of the periodic load test that will not be performed.

- (2) Rationale for not performing the load test, including at least the following:
- (a) Sling design standard(s)
 - (b) Sling design safety factor(s)
 - (c) Sling rated load versus actual load
 - (d) Sling test history
 - (e) Sling operations history
 - (f) Sling planned future use
 - (g) Sling material / construction properties
 - (h) Sling storage provisions
 - (i) Sling maintenance history
- (3) Other information that is acceptance rationale not to perform the periodic load test.

10.3 TRANSIT OF CRANES

Transit of cranes shall be in compliance with ASME B30.5, Mobile and Locomotive Cranes.

10.4 SUSPENDED LOAD OPERATIONS

- a. All suspended load operations shall have an active KSC Suspended Load Operation Analysis/Approval (SLOAA) prior to performance of the operation.

Note 1: SLOAA reports are posted at the following web site: <https://sma.ksc.nasa.gov/LDE>.

Note 2: These requirements implement at KSC the "National Aeronautics and Space Administration Alternate Safety Standard for Suspended Load Operations" found in [NASA-STD-8719.9, Lifting Standard](#). This standard has been approved by the OSHA as an alternate to 29 Code of Federal Regulations (CFR) § 1910.179(n)(3)(vi), 29 CFR § 1910.180(h)(3)(vi), and 29 CFR § 1910.180(h)(4)(ii).

- b. The operating organization shall prepare the SLOAA report using the KSC-specific KSC Form 20-200, Approval Sheet for Suspended Load Operations.

10.5 OPERATIONAL REQUIREMENTS DURING LIGHTNING

10.5.1 CRANE OPERATIONS IN EXPOSED AREAS AND WITHIN NONLIGHTNING-PROTECTED FACILITIES

- a. Personnel shall not commence crane operations outside of any facility or inside a facility that is not lightning-protected during a Phase II Lightning Warning or when a lightning hazard exists.

b. When a Phase II Lightning Warning is issued or when a lightning hazard exists, crane operations outside of any facility or inside a facility that is not lightning-protected shall be halted and placed in a safe configuration for the duration of the Phase II Lightning Warning period or until the lightning hazard no longer exists.

10.5.2 CRANE OPERATIONS WITHIN LIGHTNING-PROTECTED FACILITIES

a. Personnel may perform crane operations within lightning-protected facilities during Phase II Lightning Warnings or when a lightning hazard exists without any additional precautions, except when operations involve explosives or flammable/combustible commodities.

b. Crane operations involving containers or equipment containing explosives or flammable/combustible commodities inside a lightning-protected facility during a Phase II Lightning Warning shall be permitted when one of the following bonding methods is used:

(1) Bonding straps were connected from the load to the hook prior to the announcement of the Phase II Lightning Warning, or

(2) An insulated jumper clamp and cable is used to make and break all ground connections during the Phase II Lightning Warning.

Note: Bonding straps AND insulated jumper clamp and cable should not be used at the same time.

c. Bonding strap and grounding cable operations shall be performed in the following order:

(1) Connect a grounding cable from a labeled facility ground to the hook.

(2) Connect a bonding strap from the load to the hook.

(3) Hook onto the load and commence the lift.

(4) If the lift is of such a height or distance that the grounding cable cannot remain connected during the entire operation, then disconnect the grounding cable at the facility ground after the load is lifted clear of the supporting structure, and if possible reconnect it to facility ground at the destination site.

Note: The grounding cable should not be removed during a Phase II Lightning Warning when operations involve explosives or flammable/combustible commodities.

(5) Disconnect bonding straps and grounding cables in the reverse order of installation after the lift is complete.

d. When inside a lightning-protected facility, crane operations which involve containers or equipment containing explosives or flammable/combustible fluids and which cannot meet the steps in item 10.5.2.b shall be temporarily halted and placed in a safe configuration for the duration of the Phase II Lightning Warning period or until the lightning hazard no longer exists.

APPENDIX A: DEFINITIONS

Acceptance: (*SMA Request for Relief*) Taking the responsibility for the potential outcome of a documented increase in risk.

Affected Employee(s): (*Lockout/Tagout*) Those employees who operate or use the equipment being serviced or maintained, or others in the area where equipment is locked or tagged out.

Alteration: (PVS) Change that affects the pressure containing capability of a pressure vessel. Nonphysical changes such as an increase in the maximum allowable working or design pressure (internal or external) or design temperature of a pressure vessel is considered an alteration. A reduction in minimum temperature such that additional mechanical tests are required is also considered an alteration. See ANSI/NB-23, Chapter 1, Glossary of Terms.

Applicable NCS (Codes, Standards, or Guides): Any national consensus code, standard or guide, or any NASA KSC accepted design code, standard or guide for the design verification of pressure vessels, systems, or their components.

Approval: (*SMA Request for Relief*) Decision by the SMA TA that the request for relief is for relief from NASA policy and may be implemented after the appropriate person accepts the risk.

Authorized Employees: (*Lockout/Tagout*) Those employees who service or maintain equipment and perform lockout/tagout procedures.

Buddy System: An arrangement used when risk of injury is high, where personnel work in pairs with one person in the pair stationed nearby, not directly exposed to the hazard, to serve as an observer to render assistance if needed.

Caution: A notation before an operational step which, if not adhered to or observed, could result in damage to equipment.

Certification: (PVS) Documentation qualifying a vessel or system to operate in its particular service. GSE/Ground System functional validation of each critical function by test, analysis, or similarity.

Cleared Area: An area where a hazardous condition exists or a hazardous operation is in progress; personnel are prohibited from entering.

Close Call: An event in which there is no or minor injury requiring first aid, or no or minor equipment or property damage (less than \$20,000), but which possesses a potential to cause a mishap.

Compartment: Areas not meeting the definition of confined space but which require controlled entry due to hazards to personnel.

Competent Person: (*Electrical Extension Devices*) An individual who, by way of training or experience, is knowledgeable of applicable standards, is capable of identifying workplace hazards relating to the specific operation, is designated by the employer, and has authority to take appropriate actions by OSHA's definition a competent person.

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Concurrence: (SMA Request for Relief) Formal documentation of an agreement/recommendation/ opinion, but with no authority to approve or accept risk.

Confined Spaces: Spaces large enough and configured to allow an employee to bodily enter and perform assigned work; has limited or restricted means for exit; and is not designed for continuous employee occupancy.

Consequence (Severity): An assessment of the worst case credible potential effect(s) of a risk without any controls in place that is documented in terms of a consequence/severity level using the applicable risk matrix.

Control Area: A designated, limited-access area where a hazardous condition exists or a hazardous operation is in progress; nonessential personnel are prohibited from entering.

Control Point: The area or place where the task leader and any other support groups direct and monitor the operation.

Credible: A condition that can occur and is reasonably likely to occur. A condition is considered reasonably likely to occur (using numeric data if available), if conditions or failure modes have a probability of occurrence greater than 1×10^{-6} in the projected usage/life of the equipment.

Critical Lift: Lifts during which failure/loss of control presents an elevated risk of serious injury, loss of life, or loss of one-of-a-kind articles, high dollar items or major facility components whose loss would have serious programmatic or institutional impact. Lifts of high-value flight hardware and/or non-routine lifts (e.g., lift point below center of gravity) are usually classified as critical lifts, while lifts of small, improvised mini-satellites, for example, most likely would not be. Lifting and movement of flight hardware components packaged per applicable shipment specifications are typically not classified as critical lifts.

De-Rating: (PVS) The lowering of the maximum allowable working pressure or narrowing of the allowable operating temperature range of a pressure vessel or system.

Dead Front: (*Electrical Extension Devices*) Without live parts exposed to a person on the operating side of the equipment.

Design Burst Pressure: (PVS) The theoretical pressure at which a vessel or other pressurized component would burst, based on calculations using accepted formulas and material properties. Vessels and systems to be placed in service are never subjected to a burst pressure test.

Design Pressure: (PVS) The pressure used in the design of a vessel or system for the purpose of determining minimum permissible thickness or physical characteristics of the different parts. When applicable (for liquids), static head will be added to the design pressure to determine the thickness of any specific part of a vessel. (Reference Appendix 3, Paragraph 3-2, ASME Code, Section VIII, Division 1, and Paragraph 301.2, ASME B31.3).

Deviation:

(General) An authorization for temporary relief in advance from a specific requirement, requested during the formulation/planning/design stages of a program/project operation to address expected situations. OSHA refers to this as an alternate or supplemental standard.

(SMA Request for Relief) An SMA Request for Relief that authorizes temporary relief in advance from a specific requirement and is requested during the formulation/planning/design stages of a program/project operation to address expected situations.

(Documented Procedures) Documented and approved permission that authorizes the addition, deletion, or modification of steps or sequences in a Category I or Category II documented procedure. KSC Form 4-30A can be used for this purpose.

Directed Requirement: An SMA requirement that has been imposed on NASA SMA as a flowdown of a requirement from a level higher to or outside of OSMA.

Documented Procedure: A written communication that identifies and directs work to be performed and provides the detailed instructions necessary to accomplish a task.

Electroexplosive Device (EED): A device containing some reaction mixture (explosive or pyrotechnic) that is electrically initiated. The output of the initiation is heat, shock, or mechanical action. EED Categories – EEDs are categorized based on the effects of inadvertent initiation. EED categories are as follows:

- a. Category A: EEDs which, by the expenditure of their own energy, or because they initiate a chain of events, may cause injury of death to people or damage to property.
- b. Category B: EEDs, which, in themselves, or by initiating a chain of events, will not injure people or damage property.

Emergency Instructions: *(Documented Procedures)* Instructions contained within a documented procedure that provide for safing hardware and for implementing emergency actions required to evacuate or safeguard personnel and prevent or limit the extent of damage should an emergency arise.

Emergency Procedures Document (EPD): A document produced for work areas to provide the processing teams with procedures to be followed if an emergency occurs at any time in that facility.

Essential Personnel: The number of personnel required within the control area for a particular operation as documented in the procedure.

Explosive: Any chemical compound or mechanical mixture that, when subjected to heat, impact, friction, detonation, or other suitable initiation, undergoes a very rapid chemical change with the evolution of large volumes of highly heated gases that exert pressures in the surrounding medium. The term applies to materials that either detonate or deflagrate.

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Explosives Test Equipment: Electrical circuit test equipment used for testing explosives items, pyrotechnic devices, or circuits connected to those items before or after installation.

Extension Device: (*Electrical Extension Devices*) Extension cord, power strip, wall multi-outlet plug that increases the number of outlets, power plug adapter.

Facility: Buildings, structures, and other real property improvements including utilities and collateral equipment.

Flexhose: There are two basic types of flexhoses – those constructed entirely of metal, herein described by the term “metal hose,” and those constructed of elastomeric material or a combination of elastomeric material and metal, herein described by the term “nonmetallic hose”.

- a. **Metal Hose:** A metal hose consisting of a flexible metal pressure carrier tube surrounded by an outer layer of wire braid (some low pressure metal hoses do not utilize an outer layer of wire braid). The flexible metal pressure carrier tube and the wire braid are attached to the hose end fittings by welding, silver-soldering, or brazing (some metal hoses used for cryogenic applications utilize an inner and outer flexible metal tube with a vacuum in the space between the inner and outer flexible tubes).
- b. **Nonmetallic Hose:** A nonmetallic hose consists of a polytetrafluoroethylene or other flexible elastomeric material pressure carrier tube reinforced by fabric or wire braid with metal end fittings attached by mechanical means such as swaging or crimping.

Flight Hardware: Hardware designed and fabricated with the intent to fly.

Flight Termination System: A type of range safety system designed, tested, and incorporated into vehicles that provides for the independent and deliberate termination of an errant/erratic vehicle's flight.

Fracture Mechanics: An engineering concept used to predict flaw growth and fracture behavior in materials and structures containing cracks or crack-like flaws.

Ground-based PVS: (PVS) All PVS, including PVS based on barges, ships, or other transport vehicles, not specifically excluded in this document. Flight PVS used for their intended purpose aboard active air or space craft, even though on the ground, are not included in this definition, but flight PVS converted to ground use are included.

Ground-Fault Circuit-Interrupter (GFCI): (*Electrical Extension Devices*) A device intended for the protection of personnel that functions to deenergize a circuit or a portion of a circuit within an established period of time when a current to ground exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit.

Ground Support Equipment (GSE): Ground-based equipment used to store, transport, handle, test, check-out, service, and control aircraft, launch vehicles, spacecraft, or payloads.

Hazard: A condition that has the potential to result in or contribute to injury, death, or equipment damage.

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Hazard Analysis: Identification and evaluation of existing and potential hazards, and the recommended mitigation for the hazard sources found.

Hazardous Energy: (*Lockout/Tagout*) Any electrical, mechanical, hydraulic, pneumatic, chemical, nuclear, thermal, gravity, or other energy that could cause injury to personnel.

Hazardous Fluids: (*PVS*) Gases or liquids of such a nature that a given quantity of the gas or liquid's vapor, when mixed or unmixed with air, is hazardous to personnel or equipment due to flammability, toxicity, or extremes of temperature. The following fluids are considered to be hazardous; additional fluids may be designated to be hazardous at the discretion of the KSC PSM.

- a. Alcohol
- b. Ammonia
- c. Gaseous Hydrogen
- d. Hydrazine
- e. Liquefied Petroleum Gases (Propane, Butane, as defined in NFPA 58)
- f. Liquid Air
- g. Liquid Hydrogen
- h. Liquid Nitrogen
- i. Liquid Oxygen
- j. Monomethylhydrazine
- k. Nitrogen tetroxide
- l. Trichloroethylene

Hazardous Material: Any solid, liquid, or gaseous material which meets the hazard reporting requirements of 29 CFR 1910.1200. This includes commodities that, under foreseeable conditions, are toxic, carcinogenic, cryogenic, explosive, flammable, pyrophoric, water-reactive, corrosive, an oxidizer, a compressed gas, a combustible liquid, or are chemically unstable.

Hazardous Operation (Hazardous Tasks): Any operation or other work activity that has a high potential to result in loss of life, serious injury to personnel or public, or damage to property due to the material or equipment involved or the nature of the operation/activity itself.

Hydrostatic Test: (*PVS*) The test of a pressure vessel or system during which the vessel or system is filled with a liquid (usually water) and pressurized to a designated level in a manner prescribed in the applicable code. (Reference Paragraph UG-99, ASME Code, Section VIII, Division 1 or Part 8 Paragraph 8.2, ASME Code, Section VIII, Division 2., Paragraph 345.4, ASME B31.3)

Hydraulics: (*PVS*) Hydraulic systems using commercially available hydraulic fluid.

Note: Associated pneumatic storage, actuation devices, or components that are used in a hydraulic system are not considered hydraulics. Pressurized hydraulic fluid containing devices are included if the system is included.

Inactive Vessels/Systems: (*PVS*) These are vessels/ systems which are not in service because of changes in program requirements and have no current planned usage but have not been determined to be unsafe.

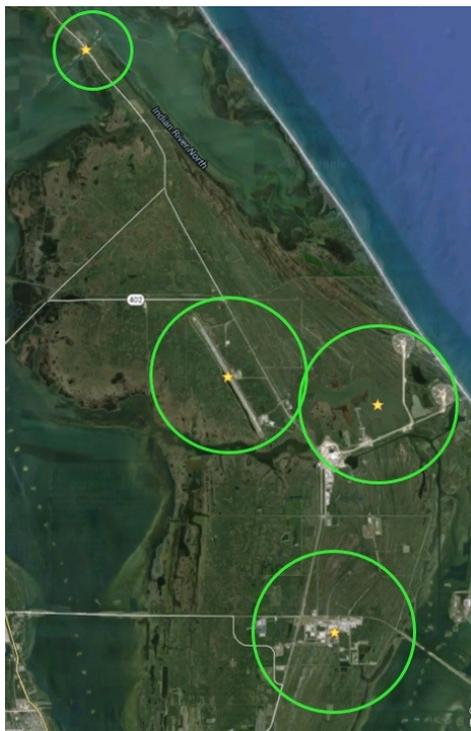
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Inservice Inspection (ISI): (PVS) A periodic inspection of a vessel or system while in service. If required, the vessel or system will be inoperative during the inspection.

Inservice Inspection (ISI) Plan: (PVS) The plan is a list of inspections and tests and the frequency to be performed on the pressure vessels and pressurized systems.

Lightning Hazard Notification Area (LHNA): A circular area used by weather forecasters for estimating the risk to personnel due to a lightning hazard. At KSC there are 4 LHNAs: 1) Haulover (center of 28.73640n 80.75470w, 0.75 nm radius), 2) LC39 (center of 28.60419n 80.63170w, 1.75 nm radius), 3) SLF (center of 28.61475n 80.69486w, 1.75 nm radius), and 4) Industrial Area (center of 28.52000n 80.65000w, 1.75 nm radius).

LHNAs were created as an efficient way to manage lightning risk. Considering the large concentration of personnel in those areas and the large number of operations occurring in those areas, it was easier to create a few LHNAs that protected a large percentage of personnel and equipment, instead of creating individual risk forecasts for each person and system at KSC.



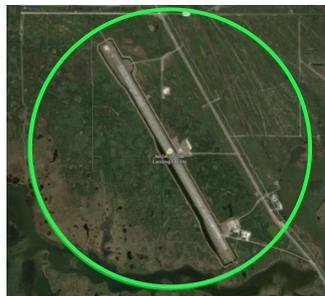
KSC LHNA



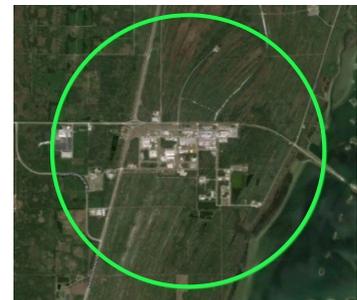
Haulover 0.75 nm radius



**Launch Complex 39 (LC39)
1.75 nm radius**



**Shuttle Landing Facility
1.75 nm radius**



**Industrial Area
1.75 nm Radius**

Lethal Fluids: (PVS) Poisonous gases or liquids of such a nature that a very small amount of the gas or liquid mixed, or unmixed with air, is dangerous to life when inhaled. See ASME Code, Section VIII, Division 1, Paragraphs UW-2 and UCI-2, Division 2, Paragraph AG 301.1, and ASME B31.3, Appendix M. Examples include:

- a. Aerozene 50
- b. Hydrazine

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- c. Monomethyl Hydrazine
- d. Nitrogen Tetroxide
- e. Unsymmetrical Dimethyl Hydrazine

Lifting Devices and Equipment Manager (LDEM): Person designated by the Center Director, who is responsible for overall management of the installation lifting devices and equipment program, coordinating with appropriate personnel at their installation on lifting issues, and SMA providing their installation's position on lifting devices and equipment safety issues.

Likelihood (of Occurrence): An assessment of the likelihood or probability of a hazard's most severe effects transpiring. Likelihood (probability) takes into account that the hazard controls are in-place and effective.

Listed: (*Electrical Extension Devices*) When referring to a material or device used in conjunction with fire protection, a product that has been tested by a recognized and independent research laboratory (e.g., Underwriters Laboratories and Factory Mutual), in accordance with generally accepted and standardized test methods and verified that it will perform adequately and dependably under adverse conditions.

Lock: Lockout/tagout device that physically prevents the use of equipment or machinery.

Lockout Device: A mechanical block with a lock and key, or combination type, designed to secure an energy-isolation device in the safe position and prevent the energizing of equipment or machinery.

Lockout/Tagout: The process of configuring equipment in a temporary condition in which the release of energy is prevented from endangering personnel performing servicing and maintenance. The placement of a lock/tag on the energy isolating device in accordance with the established procedure, indicating that the energy isolating device shall not be operated until removal of the lock/tag in the accordance with the established procedure.

Major Control Area: A controlled access area (usually greater than a 50-foot radius of the hazardous task) in which access management requires additional positive controls to ensure the safety of personnel.

Manloading: The maximum number of personnel permitted to occupy a defined area at a single time.

Maximum Allowable Working Pressure (MAWP): (PVS) The maximum gauge pressure permissible at the top of a completed vessel in its operating position for a designated temperature. This pressure is based on calculations for every element of the vessel using nominal thickness exclusive of allowances for corrosion and thickness required for loading other than pressure. It is the same as the design pressure for all cases where separate calculations are not made to determine MAWP. The MAWP is the basis for the pressure setting of the pressure relieving devices protecting the vessel.

Maximum Operating Pressure (MOP): (PVS) The highest pressure at which a vessel or system component normally operates. This pressure is based on operating requirements and

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may not exceed the MAWP or design pressure. MOP is synonymous with maximum expected operating pressure or maximum working pressure.

Mishap: NASA Mishap: An unplanned event resulting in at least one of the following:

- a. Occupational injury or occupational illness to non-NASA personnel caused by NASA operations.
- b. Occupational injury or occupational illness to NASA personnel caused by NASA operations.
- c. Destruction of or damage to NASA property, public or private property, including foreign property of caused by NASA operations or NASA-funded research and development projects.
- d. NASA mission failure before the scheduled completion of the planned primary mission (At KSC report all government property damage of at least \$5000).

For purposes of investigation and reporting, mishaps are categorized as: Type A, B, C, and D Mishaps and Close Calls (refer to [NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping](#)).

National Consensus Standard (NCS): (PVS) Any standard, or modification thereof: (1) adopted or promulgated by a nationally recognized standards-producing organization using procedures that demonstrate to the Secretary of Labor for Occupational Safety and Health that those persons interested in or affected by the standard have reached substantial agreement on its adoption; (2) formulated so that an opportunity existed for diverse views to be considered; and (3) designated by the Secretary or the Assistant Secretary, after consultation with other appropriate Federal agencies.

Note: A standard, as defined, requires appropriate conditions or activities to provide a safe and healthful employment environment.

Non-Safety-Related Discrepancy: (PVS) Any discrepancy that does not increase the potential for injury or death to personnel or damage to hardware.

Nondestructive Examination: (PVS) The application of technical methods to examine materials or components in ways that do not impair future usefulness and serviceability in order to detect, locate, measure, and evaluate flaws; to assess integrity, properties, and composition; and to measure geometrical characteristics.

Operating Organization: The organization who is responsible for systems/operations.

Operating Pressure: (PVS) The gauge pressure at which a vessel (top of the vessel) or system normally operates. For a vessel, the operating pressure does not exceed MAWP/design pressure, and for a system, it does not exceed the design pressure.

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Operating Temperature: (PVS) The metal temperature that will be maintained in the part of the vessel or system under consideration during normal operation.

Owner: (PVS) The management of the organization responsible for the PVS as defined in [NPD 8710.5, Policy for Pressure Vessels and Pressurized Systems](#).

Personal Protective Equipment: Equipment designed to protect workers from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards.

Phase I Lightning Watch: A 45th Weather Squadron notification that lightning is expected to create a credible risk to personnel located inside a lightning hazard notification area (LHNA) within 30 minutes. The lightning risk estimate is most accurate for the geographical center of the LHNA, and is underestimated for personnel located between the center of the LHNA and the approaching storm, and is overestimated for personnel located away from the center of the LHNA with respect to the approaching storm. Weather forecasters use models, radar data, and algorithms to predict and forecast when a lightning hazard poses a credible risk of striking inside an LHNA. When a weather event capable of producing lightning is projected, based on speed and wind direction, to reach a specified distance from the center of an LHNA in 30 minutes, a Phase 1 Lightning Watch is issued. Specified distances for KSC are: 5 nautical miles (nm) from the center of the Haulover LHNA, 6 nm from the center of the SLF LHNA, 6 nm from the center of the LC39 Area LHNA, and 6 nm from the center of the Industrial Area LHNA. A Phase 1 lightning watch provides personnel located inside an LHNA time to cease operations if a Phase II warning is subsequently issued.

Phase II Lightning Warning: A 45th Weather Squadron notification that lightning is creating a credible risk to personnel located within a lightning hazard notification area (LHNA). Personnel must cease operations and take shelter if not inside a lightning protected facility or cease operations if inside a lightning protected facility but working on electrically conductive systems that extend beyond the facility's lightning protected boundary. Weather forecasters use climatological data to determine the frequency of lightning strikes within a specified distance from the center of an LHNA and lightning detection instrumentation to confirm if lightning has occurred within an LHNA. At KSC, the specified distance is 5 nautical miles (nm) from the center of the Haulover LHNA, 6 nm from the center of the SLF LHNA, 6 nm from the center of the LC39 Area LHNA, and 6 nm from the center of the Industrial Area LHNA.

Pneumatic Test: (PVS) A test of a pressure vessel or system in which a gas is introduced and pressurized to a designated level in a manner prescribed in the applicable code. (Reference Paragraph UG-100, ASME Code, Section VIII, Division 1, or Part 8 Paragraph 8.3, ASME Code, Section VIII, Division 2, and Paragraph 345.5, ASME B31.3.)

Power Strip: (Electrical Extension Devices) (Also known as a plug board, power board, power bar, distribution board, gang plug, plug bar, multibox, extension lead, or relocatable power tap) is a strip of sockets that attaches to the end of a flexible cable and allows multiple devices to be plugged in.

Pressure Relief Device: (PVS) A pressure relief device designed to actuate on inlet static pressure and to reclose after normal conditions have been restored. This includes relief valves, safety valves, and safety relief valves.

Note: This definition is that of ASME PTC 25-2001.

Pressure System: (PVS) An assembly of components under pressure, including vessels, piping, valves, relief devices, pumps, expansion joints, gauges, etc. This includes pressurized and vacuum systems, unless otherwise specifically excluded.

Pressure Systems Manager (PSM): (PVS) The individual designated by the KSC Center Director who is responsible for the overall management of the KSC Pressure Vessel/Systems (PVS) Certification Program. The KSC PSM resides in the SMA Technical Management Division.

Pressure Test: See **Hydrostatic Test** and **Pneumatic Test**.

Pressure Vessel: (PVS) Any vessel used for the storage or handling of gas or liquid under positive or negative pressure.

Pretask Briefing: A briefing held immediately prior to the start of (a) hazardous sequence(s), which details the hazard(s) and objective(s) associated with that particular sequence.

Pretest Briefing: A briefing held prior to the start of a hazardous operation with a major control area, which details the hazard(s) and objective(s) of the operation and confirms that all operational and support elements are ready.

Program/Project or Directorate Organization: The Government/contractor organization having direct responsibility for performing a task associated with: assembly/ disassembly, checkout, maintenance, servicing, repair, and operation of GSE or flight hardware/systems.

Rated Load: The static weight the basic equipment can safely support or lift.

Receptacle: (*Electrical Extension Devices*) A receptacle is a contact device installed at the outlet for the connection of an attachment plug. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.

Recertification: (PVS) The procedure (appropriate tests, inspections, examinations, analyses, and documentation), which qualifies a previously certified vessel or system to continue or be returned to operation at a designated pressure. Also applies to GSE.

Recertification Interval: (PVS) The time between recertifications when a certified status is maintained through documented periodic examinations and inspections to determine acceptable vessel or system condition. This time period must be determined when the ISI plan is developed, and the length of this period will depend on the results of the initial and subsequent inspections, tests, and engineering analyses.

Relocatable Power Tap: (*Electrical Extension Devices*) See **Power Strip**

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Repair: (PVS) The work necessary to restore a pressure vessel or system to a safe and satisfactory operating condition, provided there is no deviation from the original design.

Request for Relief: A waiver, deviation, or request for determination of non-applicability to modify or eliminate a stated requirement and usually not meet the full intent and letter of the requirement as stated.

Request for Relief Coordinator: Safety and Mission Assurance Resource and Integration Office employee responsible for the requirements, process, and coordination of requests for relief.

Risk: The combination of the likelihood (qualitative or quantitative) that an activity will experience an undesirable event and the consequence/severity of the undesired event were it to occur.

Risk Assessment: (*Safety*) Process of qualitative risk categorization or quantitative risk (safety) estimation, followed by the evaluation of risk significance.

Safety Factor: Ratio of the design ultimate breaking strength of a member, material, structure, or equipment and the maximum working stress of safe permissible load expected during ordinary use.

Safety-Related Hardware Discrepancy: (PVS) Any hardware discrepancy that could increase the potential for injury or death to personnel or damage to hardware.

Safety or Safety Representative: The term Safety is used without context to contractor or NASA personnel. The phrase "NASA SMA" is used to mean a Government Safety representative only.

Set Pressure: (PVS) The pressure at which a pressure relief device is set to operate. Set to operate means the set pressure of a relief valve or spring-loaded nonreclosing device, the bursting pressure of a rupture disk device or the breaking pressure of a breaking pin device. (Reference Paragraphs UG-125 and UG-134, ASME Code, Section VIII, Division 1, and Part9 paragraph 9.1.4, ASME Code, Section VIII, Division 2.)

Shall (SMA): A mandatory SMA requirement. Noncompliance with a "shall" statement requires approval of a SMA Request for Relief.

Should: An SMA rule/requirement that is recommendation (guidance). The advisability of a "should" statement depends on the specific facts in a given situation. Implementation of a "should" statement is at the discretion of the responsible KSC program/project or directorate organization.

Stop Work Authority (Safety): Authority provided to all employees at KSC to stop work or work tasks that pose an imminent danger to the employee(s) performing the work or others in the area. The authority is limited to the location where the imminent danger is present.

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System Safety: Application of engineering and management principles, criteria, and techniques to optimize safety and reduce risks within the constraints of operational effectiveness, time, and cost throughout all phases of the system life cycle.

Tag: Lockout/tagout device that alerts workers regarding equipment/machinery status.

Tagout Device: A prominent warning means such as a tag and a means of attachment, which can be securely fastened to an energy isolating device and the equipment being controlled.

Unsafe Pressure Vessels or Systems: (PVS) These are vessels or systems, which have been determined to be unsafe for service.

Waiver: A SMA Request for Relief that authorizes temporary relief from a specific requirement after the fact. Requested during the implementation of a project or operation to address situations that were unforeseen during design or advanced planning.

Warning: A notation which if not adhered to or observed could result in loss of life, personal injury, or exposure.

Workweek: Any seven day period beginning on Sunday and ending on Saturday, or other seven day period, as specified and documented by an organization for accounting purposes.

APPENDIX B: ACRONYMS AND ABBREVIATIONS

45WS	Air Force 45 th Weather Squadron
AFGE	American Federation of Government Employees
AHJ	Authority Having Jurisdiction
AIAA	American Institute of Aeronautics and Astronautics
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CDE	Center Declared Emergency
CFR	Code of Federal Regulations
COPV	Composite Overwrapped Pressure Vessel
CSO	Chief Safety and Mission Assurance Officer
DOT	Department of Transportation
EE&SE	Emergency Eyewash and Shower Equipment
EED	Electroexplosive Device
EPD	Emergency Procedures Document
ERP	Emergency Response Plan
ESO	Explosives Safety Officer
ETE	Explosives Test Equipment
GFCI	Ground Fault Circuit Interrupter
GRRP	Ground Risk Review Panel
GSE	Ground Support Equipment
HQ	Headquarters
ISI	Inservice Inspection
JHA	Job Hazard Analysis
KATS	Kennedy Action Tracking System
KDP	Kennedy Documented Process
KNPD	Kennedy NASA Policy Directive
KNPR	Kennedy NASA Procedural Requirements
KSC	Kennedy Space Center
KTI	Kennedy Technical Instruction
lb/in ²	pound per square inch
LC39	Launch Complex 39
LDEM	Lifting Devices and Equipment Manager
LH ₂	Liquid Hydrogen
LHNA	Lightning Hazard Notification Area
LOTO	Lockout/Tagout
LSAC	Lightning Safety Assessment Committee
MAWP	Maximum Allowable Working Pressure
MDCP	Mechanical Damage Control Plan
MMH	Monomethylhydrazine
MOP	Maximum Operating Pressure
MPa	Megapascal
MWT	Maximum Work Time
N ₂ H ₄	Hydrazine
N ₂ O ₄	Nitrogen Tetroxide
NASA	National Aeronautics and Space Administration
NBIC	National Board Inspection Code
NDE	Nondestructive Evaluation

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NFPA	National Fire Protection Association
NPD	NASA Policy Directive
NPR	NASA Procedural Requirement (document)
NSI	NASA Standard Initiator
OSHA	Occupational Safety and Health Administration
OSMA	Office of Safety and Mission Assurance
PAWS	Paging and Area Warning System
PDE	Program Declared Emergency
POC	Point-of-Contact
PPE	Personal Protective Equipment
psig	Pounds Per Square Inch Gauge
PSM	Pressure Systems Manager
PVS	Pressure Vessels and Pressurized Systems
RF	Radio Frequency
RPT	Relocatable Power Tap
S&A	Safe and Arm
SMA	Safety and Mission Assurance
SLF	Shuttle Landing Facility
SLOAA	Suspended Load Operation Analysis/Approval
SSR	Safety Statistics Record
STD	Standard
SW	Space Wing
SWI	Space Wing Instruction
TA	Technical Authority
UL	Underwriter's Laboratories

APPENDIX C: REFERENCE DOCUMENTS

C.1. Federal Agencies are mandated to provide a safe workplace for their employees in accordance with the Occupational Safety and Health Act, 1970, per Executive Order 12196, "Occupational Safety and Health Programs for Federal Employees," dated February 26, 1980, and with 29 CFR 1960 "Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters."

C.2. The requirements for the development, management, and implementation of a KSC compliant Environmental Health Program are contained in [KNPR 1840.19, KSC Industrial Hygiene Program](#). Other applicable documents are [KNPR 1820.4, KSC Respiratory Protection Program](#); [KNPR 1820.3, KSC Hearing Loss Prevention Program](#); [KNPR 1860.1, KSC Ionizing Radiation Protection Program](#); [KNPR 1860.2, KSC Nonionizing Radiation Protection Program](#); and [KNPR 1840.1, KSC Hazard Communication Program](#).

C.3. While KSC does not require a specific risk matrix be used for risk assessments, the [KSC Risk Management Scorecard](#) may be used as a reference tool.

APPENDIX D: LIST OF EXAMPLE HAZARDS/CONTROLS

The following list contains examples of Hazards/Controls that the review division will consider in their reviews of hazard assessments.

- D.1. Evaluate grounding and bonding using appropriate NFPA. ([KSC-UG-8715.3, KSC Safety User's Guide](#), Chapter 17)
- D.2. Three-phase Power Verification ([KSC-UG-8715.3, KSC Safety User's Guide](#), Section 17.4)
- D.3. Adverse Weather Restrictions
- D.4. Potential for the equipment (photographic equipment) to produce an arc or spark and the ability for components to remain securely installed within or on the camera or in remotely located equipment
- D.5. Oxygen Deficient Environments
- D.6. Handling of Flammable/Combustible Liquids near Flight Hardware
- D.7. Video Coverage of hazardous operations to improve visibility and enhance safety during emergency operations and post-operation recovery.
- D.8. Recorded voice communication and video coverage to assist in mishap investigation if a mishap occurs.
- D.9. Facility Specific Requirement
- D.10. Battery Handling ([KSC-UG-8715.3, KSC Safety User's Guide](#), Section 5.6)
- D.11. Personnel accountability during emergency situations.
- D.12. Explosive Requirements involving Humidity Levels in Operational Areas ([KSC-UG-8715.3, KSC Safety User's Guide](#), Section 10.2)
- D.13. Explosive Propellant Requirements ([KSC-UG-8715.3, KSC Safety User's Guide](#), Section 10.3)
- D.14. Launch and Landing Requirements ([KSC-UG-8715.3, KSC Safety User's Guide](#), Chapter 19 contain the requirements used for the Shuttle Program)
- D.15. Pressure system has adequate relief protection to prevent over pressurization.